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Edited by L. B. Mackenzie

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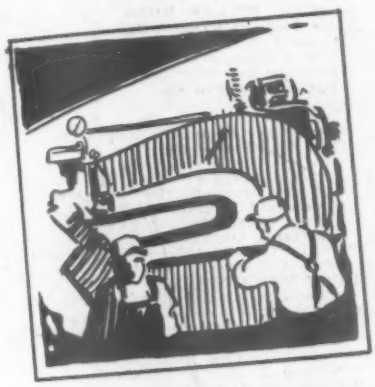
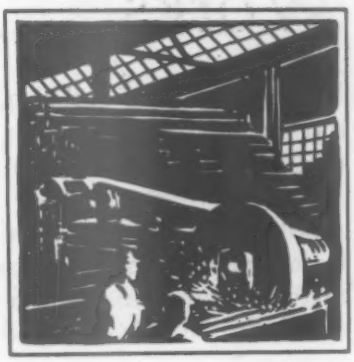


4. MECHANICALLY OPERATED SHEARS



5. FRICTION SAWS

6. OXYGEN, HYDROGEN OR ACETYLENE

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Davis-Bournonville Co.
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Hauck Mfg. Co.
International Oxygen Co.
Modern Engineering Co.
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Imperial Brass Mfg. Co.
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John A. Roebling's Sons Co.
Smith's Inventions, Inc.
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Standard Mfg. Co.
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Transportation Engineering Corp.
United States Welding Co.
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Victor Oxy-Acetylene Equipment Co.
Wilson Welder & Metals Co.

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The Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
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Hauck Mfg. Co.
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Hauck Mfg. Co.
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Superior Oxy-Acetylene Machine Co

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Imperial Brass Mfg. Co.
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Smith's Inventions, Inc.
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Universal Oxygen Co.
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Hauck Mfg. Co.
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International Oxygen Co.
Smith's Inventions, Inc.
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Universal Oxygen Co.

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California Compressed Gas Co.
Gas Products Association
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International Oxygen Co.
Universal Oxygen Co.

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Electrolytic Oxy-Hydrogen Laboratories, Inc.
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Hauck Mfg. Co.
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Imperial Brass Mfg. Co.
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K-G Welding & Cutting Co.
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Torchweld Equipment Co.
Universal Oxygen Co.
Victor Oxy-Acetylene Equipment Co.

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Peoria.....100-110 Edmund St.
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Quincy.....313 Delaware St., Phone 220
Springfield.....217 South Fourth St.
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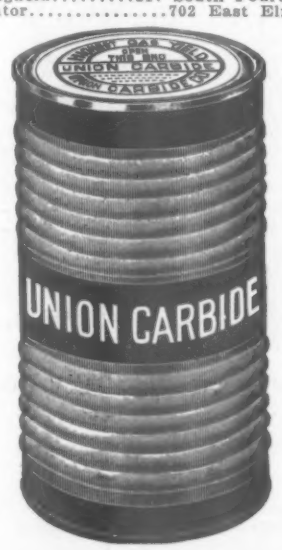

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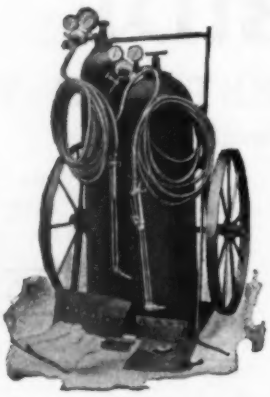

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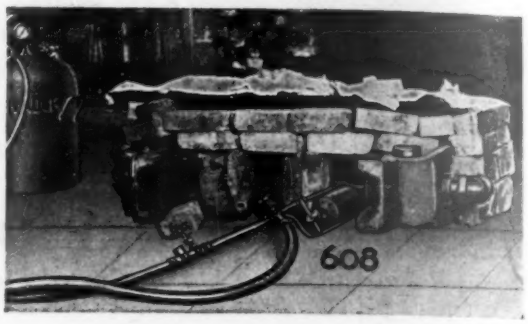

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They do the work in much quicker time with the elimination of noxious gases, smoke and ashes.

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Most efficient generator for producing Oxygen and Hydrogen

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QUALITY GUARANTEED

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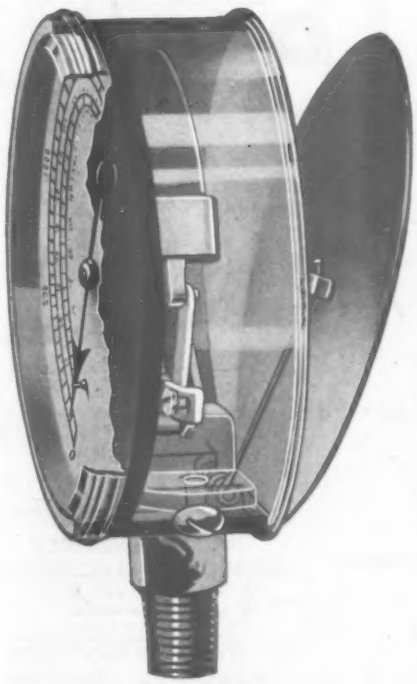

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"Weld-a-cast" is a scientific combination of chemicals, that causes the metal to melt rapidly shortening the operation, thus economizing in time, gas and oxygen.

"Weld-a-cast" adheres readily to the hot welding rod which picks up just enough and none is wasted; it does not blow away but melts at once; it eliminates blow holes and leaves the metal soft.

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MULTI-SEAT REGULATORS have four seats instead of one, but cost no more.

Write for prices and start to reduce your costs — NOW.

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"RACO" Electrodes and Welding Wire

is the adopted standard with the largest shipbuilders, railroads and industrial plants.

The mild steel used in the manufacture of "Raco" Electric Welding Wire is made by the open hearth process, the wire is made by the Reid-Avery Co., which should not be confused with jobbers.

We are in position to furnish the following sizes out of stock 3/32", 1/8", 5/32", 3/16" and 1/4" diameter.

"Raco" Electric Welding Wire is sold subject to rejection from *any cause*.

Furnished in coils or straightened and cut any length. Samples cheerfully submitted for testing.

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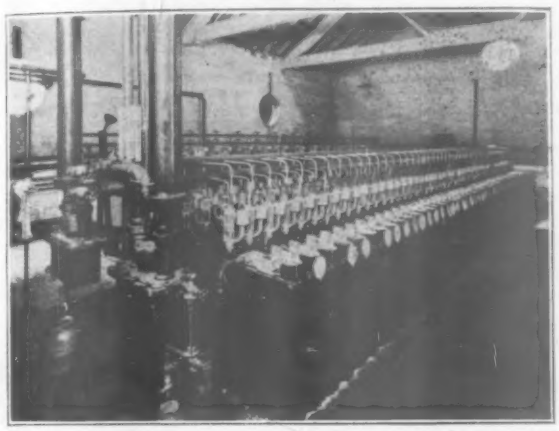
Oxygen Producing Plants That Make Good

WHEREVER they are in service LEVIN CELL installations have a reputation for making good. In many instances they have given such satisfaction that the original installations have been increased several times their capacity. The flexibility of the system makes it possible to build capacity this way. Every user of oxygen should get acquainted with the LEVIN CELL. It is simple, safe, and compact—each cell a complete gas-producing unit. It produces oxygen that is 99.8% pure, at a fraction of the cost of tank oxygen.



The convenience and economy offered by the possession of this dependable oxygen supply lead to more profitable operation. Consult our engineers on your requirements. They will gladly submit proposals based on any desired capacity.

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Under the Technical Supervision of the Electrolytic Oxy-Hydrogen Laboratories, Inc.

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PACKED IN BROWN DRUMS

For Acetylene Compressing Plants, Oxy-Acetylene Welding Plants, House Lighting Generators, Contractors' Torches, Etc.

IN 100 lb. DRUMS

In All Commercial Sizes:

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ARC WELDING EQUIPMENT

A 55-Inch Weld in 1 Hour and 50 Minutes

The main casting of this large compressor was fractured in five places when the connecting rod became disconnected.

The weld—a difficult one—required accurate work and close current regulation. A Westinghouse 175-ampere welding set was used, and the entire job—a total weld of 55 inches—was completed in one hour and 50 minutes, and with a power consumption of but 12 kw. hours.

The Westinghouse Welder more than paid for itself on this job as the cost of a new casting plus shutdown loss would have exceeded the cost of the welding equipment.

Again, Westinghouse arc welding equipment was the cheapest and quickest way, and it demonstrated its reliability on difficult jobs. Our Bulletin 7149 describes this equipment in detail. Send for your copy.

Westinghouse Electric & Manufacturing Co.
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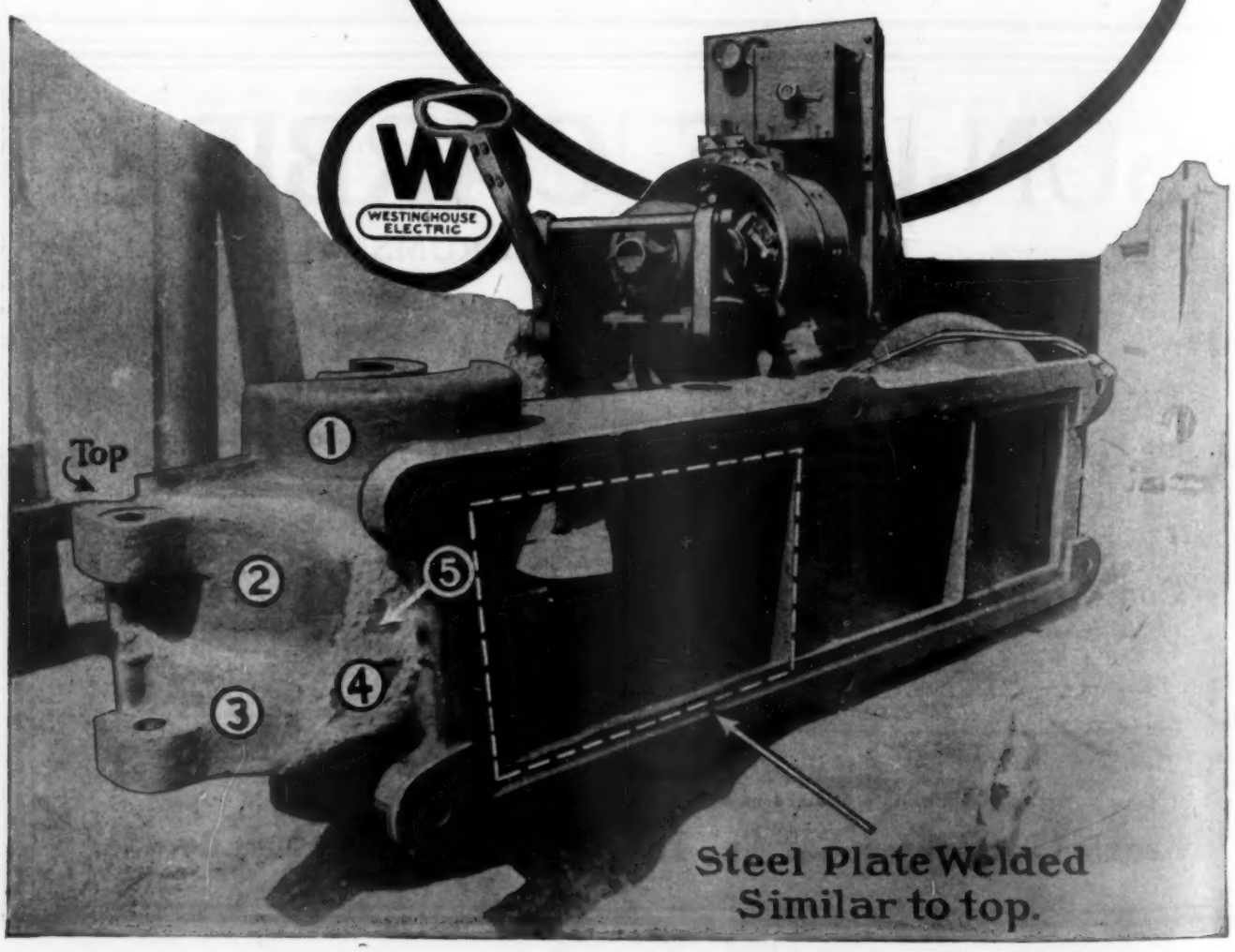
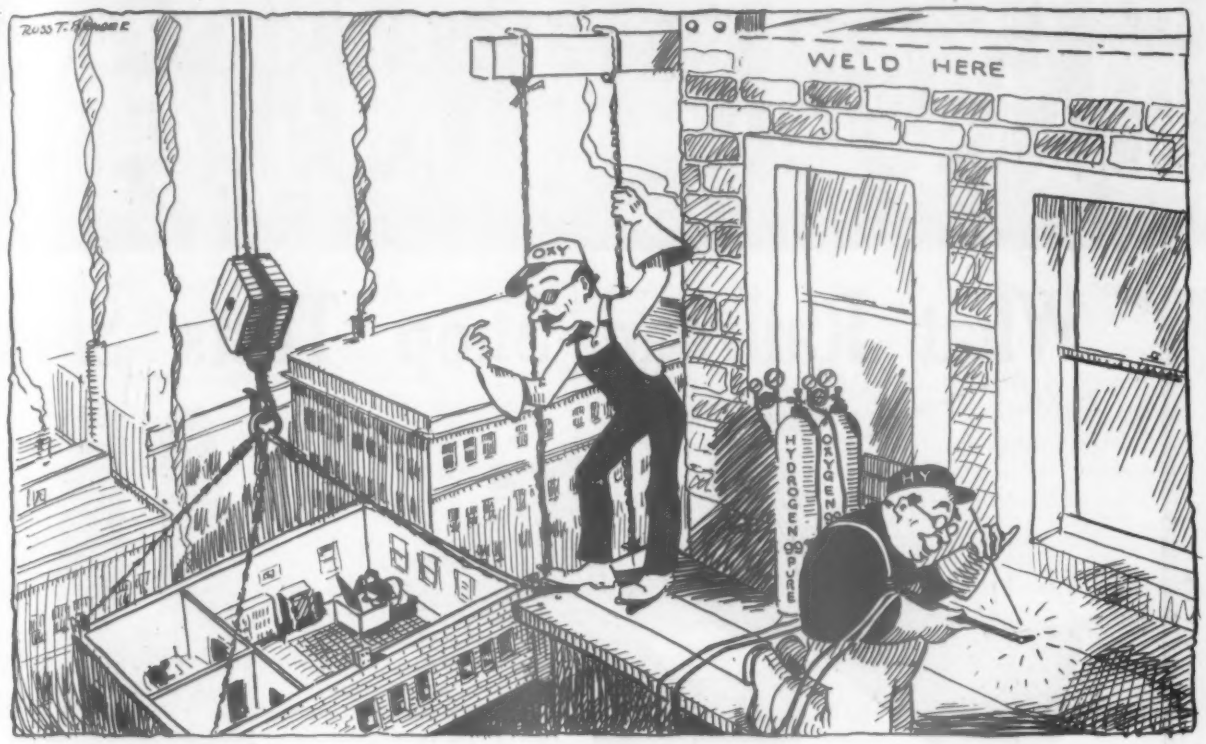
Single and multiple operator — stationary and portable types. In all sizes from 175 to 1,000 amp. Write our nearest District Office for particulars.





Oxy.—"The other day a big casting broke in Brown's machine shop. Brown and the rest of his bunch all knew that it was impossible to weld it together."

Hy.—"Well, what become of it?"

Oxy.—"Why, they fooled me. I didn't know that it was impossible to weld it and they didn't tell me, so I went ahead and did the job O. K."

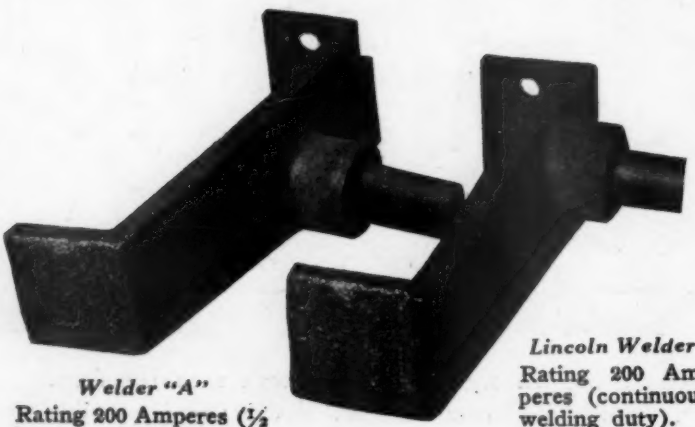
Some people will tell you that it is impossible to weld cast iron with hydrogen. A lot of men, however, don't know this and they ARE welding cast iron with the oxygen-hydrogen flame and are getting soft, machinable welds free from hard spots or pin holes. This flame contains no carbon and is the cleanest flame known.

Gas Products Association

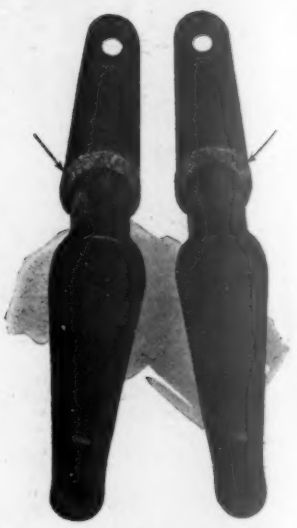
801 Marquette Building, CHICAGO, ILL.

LINCOLN ARC WELDER

What Railroad Shop Tests Show



Welder "A"
Rating 200 Amperes (½ hour intermittent).
34 minutes, 21 seconds.



Lincoln Welder
Rating 200 Amperes (continuous welding duty).
20 minutes, 17 seconds.

This photograph shows two identical repair jobs in a railroad shop building up about 5 cubic inches of material on a steel brake brace.

Welder "A"	*Lincoln Welder*
Rating 200 Amperes (½ hour intermittent).	Rating 200 Amperes (continuous welding duty).
28 minutes, 10 seconds.	17 minutes, 14 seconds.

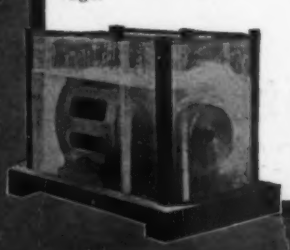
Though the welders were both rated 200 amperes, the Lincoln Welder actually used about 230 amperes and easily took care of ¼-inch electrode, while the competing welder could only use 5-32 inch electrode and consequently did much slower work.

The Lincoln Arc Welder will do at least 20 per cent more welding work per day under actual commercial welding conditions than any other electric welding equipment made.

This is a well considered statement based on results of many competitive tests, and The Lincoln Electric Co. are prepared to prove the claim at any time or place where welding is being done by commercial operators.

"Link Up with Lincoln"

This Standard Lincoln Motor operated over 3 years under water without damage.



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General Offices and Factory, Cleveland, O.

The Lincoln Electric Co., of Canada, Ltd., Toronto-Montreal

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Parsons' Manganese Bronze Rolled Welding Rods

the Strongest Bronze Made

for high-fire Brazing and Oxy-Acetylene Welding of Malleable Iron or Bronze and Brass castings assure a faultless, flawless job. This is another example of the "Cramp" standard of quality. This scientifically perfected metal is the result of long years of experience. Its fine physical properties make it especially suitable for welding purposes.

A strong weld of fine close grain and exceedingly tough texture is always the result where Cramp's Welding Rods are usesd.

We can also furnish Welding Rods of Cramp's Cast Iron, Cramp's Copper Covered Iron, Cramp's Vanadium Steel, Cramp's Drawn Aluminum, Cramp's Cast Aluminum, Cramp's American Iron and Soft Brass Brazing Wire.

CRAMP

We furnish and will be glad to estimate on all kinds of brass and bronze castings.

The William Cramp & Sons Ship & Engine Building Co., Philadelphia

Those who have enjoyed long association with CANADIAN CARBIDE have always assumed high standards of performance. We are confident that if not already among the users of CANADIAN CARBIDE the day will come when you too will know the meaning of "More Gas per Pound"

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549 McCORMICK BLDG. CHICAGO

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Oxy-Acetylene
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DAVIS-BOURNONVILLE CO. N.Y.

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Time—Efficiency—and the Greatest Number of Successful Users—have made Davis-Bournonville apparatus the standard for comparison in the Oxy-Acetylene industry.

Everything for Welding and Cutting—

From a Welding Torch to a Welding Machine.

From a Cutting Torch to a Cutting Machine.

From a Portable Outfit to a Gas Plant *and Highest Grade Welding Supplies.*

The most complete range of equipment manufactured for oxy-acetylene and oxy-hydrogen users, including acetylene generators, oxygen and hydrogen generating systems for industrial plants, portable welding and cutting outfits, shop and factory installations, and special machines for welding and cutting in factory production work.

Bulletins for your every requirement—ask for them

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Johtonns Aluminum Welding Goggles

No. 304

The Lightest Weight Welding Goggle

The Johnston Aluminum Welding Goggle complete with lenses weighs 1½ ounces. How does your present goggle compare?

The cups are made of seamless aluminum tubing, insulated with a non-conductive material which will not stick, gum nor rot. The lenses are mounted in aluminum rims which permit rapid changing. Notice the adjustable features.

The lenses are genuine Weldoglas which have met with universal favor in our fibre goggles. They screen out the harmful rays and permit good vision. Clear cover glasses protect the welding lenses.

Prices and quantity discounts furnished upon request. Ask for our new catalog on Head and Eye Protectors.

GEO. S. JOHNSTON COMPANY
Manufacturers of Hygrade Optical Products
4101 Ravenswood Avenue, Chicago, Illinois.

Columbus	Davenport	Dayton	New Orleans
Nashville	Peoria	Los Angeles	Evansville

No. 8-G for Natural Gas, $8.00

Preheating Blowpipes

The two most essential points in welding are:

FIRST: The use of a proper sized oxy-acetylene flame.

SECOND: The saving of gas by preheating your work for the oxy-acetylene flame.

The first is under your control in the use of the oxy-acetylene apparatus you have selected.

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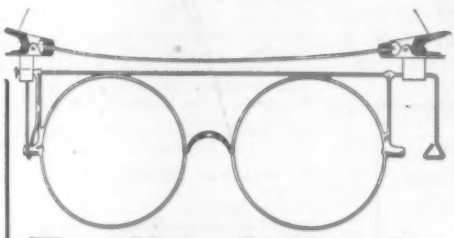

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for notice of certain legal proceedings in which our Company and the Trade are deeply interested. We have been notified, however, that "No advertisements or reading notices will be published in the 'Welding Engineer,' or the 'Welding Encyclopedia,' which relate to legal proceedings of any kind." We are therefore unable to carry out such intention, but take this means of notifying the Trade that we will be glad, upon application, to furnish full particulars.

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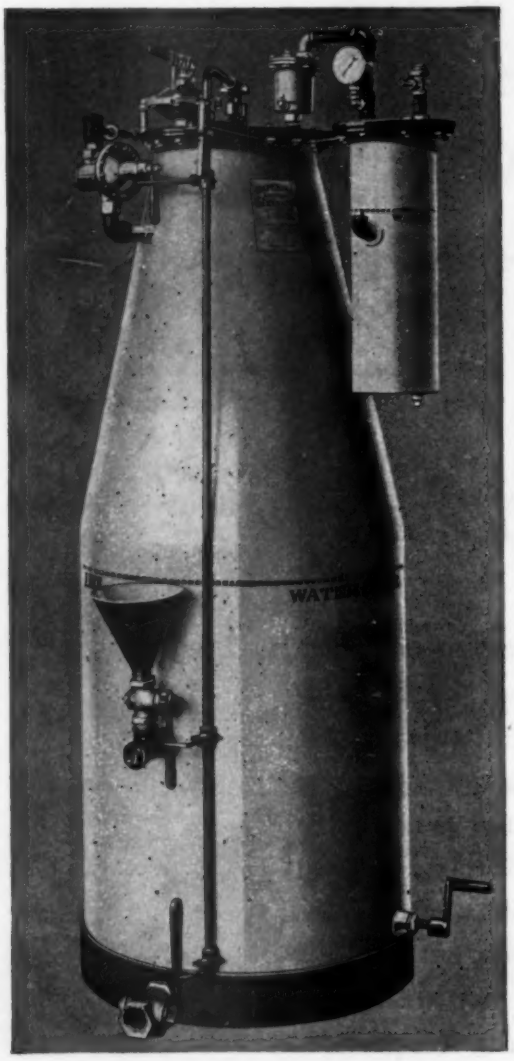

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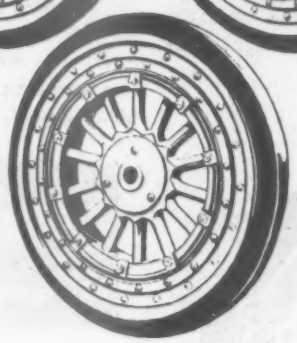
Welding Speeds Production of Truck Wheels

Arc Welding Equipment Proves to Be an Important Aid to the Manufacture of Cushion Wheels, Enabling the Factory to Fill Special Orders Without Loss of Time.



IN the factory of the Morand Cushion Wheel Company, at Chicago, Ill., an electric arc welding outfit is proving to be a source of considerable economy and convenience in production of automobile truck wheels. Steel bands, rings and channels are standard parts of the product, and are made in such a variety of sizes that there is abundant opportunity for the welder to make itself useful.

The "cushion wheel" is designed to provide the resiliency of the pneumatic tire without the danger of blowouts. The dominant idea of the construction is a resilient rubber cushion bolted top and bottom in steel channels and interposed between the felloe and the solid tire base. This is illustrated by the photograph in Fig. 1 and the sketch in Fig. 2. The cushion of live rubber takes up the road shocks, which otherwise tend to crystallize the mechanism of the truck and shorten its life. The cushion and tire are held in place by a series of steel channels and bands as shown in the cutaway illustration.

Fig. 1. Cutaway Photograph of Cushion Wheel

A large part of the welding in the manufacture of these wheels is on the steel channels and S. A. E. bands. Several standard sizes which are in demand in large quantities are rolled, but in many cases it is more economical and convenient to weld flanges to rims instead and the channel thus made is fully equal to the rolled product. The advantage of welding is especially apparent when it is necessary to provide parts of special sizes not carried in stock.

All the welding is done with a portable motor generator arc welder which is mounted on a hand truck and is easily moved from one job to another. It is usually kept in a corner of the room where the welding will not disturb the other departments. A portable metallic screen placed around the outfit prevents the radiation of the light of the arc from reaching the men in the same room. A cabinet for holding electrodes, electrode holders and leads, helmet, etc., is kept conveniently at the operator's left hand. The layout of the

Fig. 2. Details of Wheel Construction

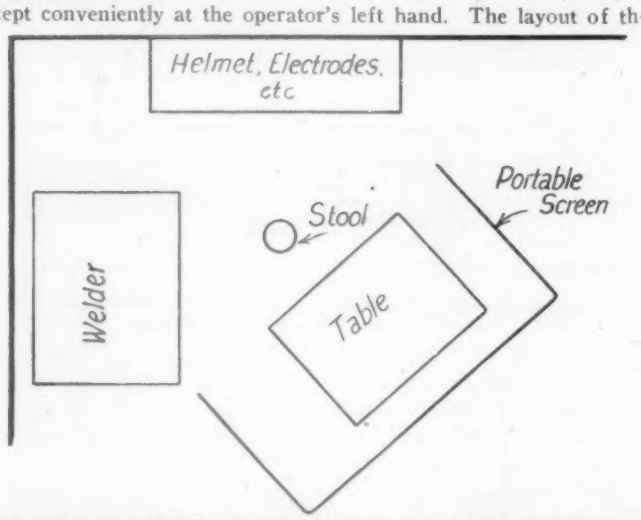


Fig. 3. Layout of Welding Department, Morand Cushion Wheel Company

welding is illustrated in Fig. 3. It permits the welding to be carried on in close proximity to other operations without loss of time and without extra handling of material.

One of the most common jobs for which the welder is used is welding flanges on hoops to form the channels. No special jigs are required for this work because the pieces can be handled easily on the welding table. The flange is set over the rim, and tack welds are made at half a dozen points equally spaced around the circumference. Instead of beveling a small opening is left between the edges to be welded. Working with a $\frac{1}{8}$-inch, low-carbon steel electrode the operator quickly welds around the tacked seam, making a slight concave reinforcement in the inside. (See Fig. 4).

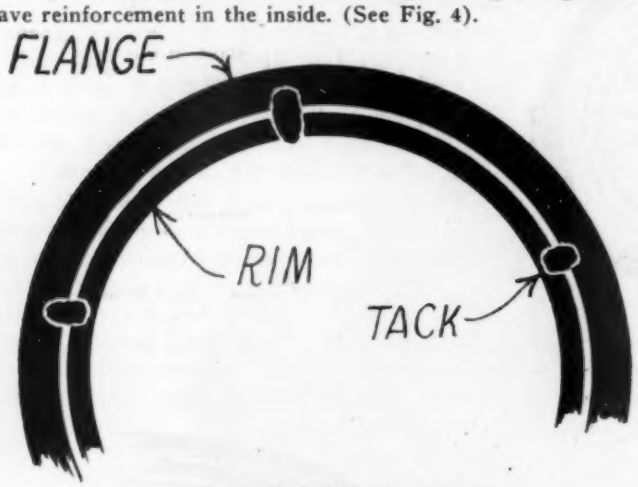


Fig. 4. Method of Welding Channels

It has been mentioned above that special sizes are readily supplied on short notice through the use of the arc welder. Fig. 5 shows the method of making two wide channels from three narrow ones. One narrow channel is cut in two and the edge of the cut beveled to a 45-degree angle. The two pieces are tacked, as in the preceding case, before welding. This operation amounts to butt welding two hoops, the design of

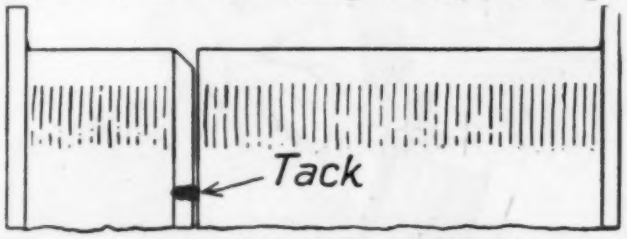


Fig. 5. How Special Sizes Are Made

the weld being a single bevel. The manufacturer who has available the facilities afforded by a welding department for turning out odd sizes and special parts in such a manner as this, saves time and money in production.

Fig. 6 shows the method of construction used on the giant

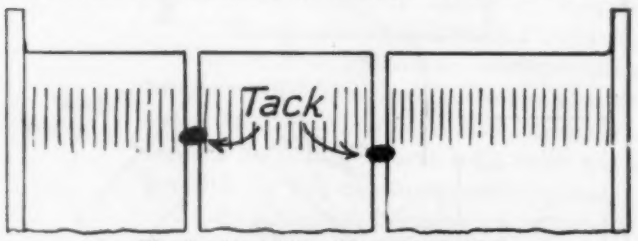


Fig. 6. Assembling Giant Wheel Rims

wheels. The steel channels are extra wide and are best made assembling three sections as shown. The sections are tacked together with a very small opening, and with no beveling and the weld is sufficiently strong when made flush so that no reinforcement is necessary.

The usefulness of the welding equipment in this plant is not entirely limited to production work. Its portability and the ease with which it can be put into operation anywhere near the shop circuit make it almost instantly available for repairing parts of machinery or equipment that get broken. Machines that might be held idle for some time awaiting the replacement of a small broken part are restored to service on short notice. Broken pieces are brought to the welder and fixed up instead of being scrapped, effecting a decrease in production losses due to imperfect materials. In fact, wherever there is a possibility of saving time and money by joining metals the welder is "on the job."

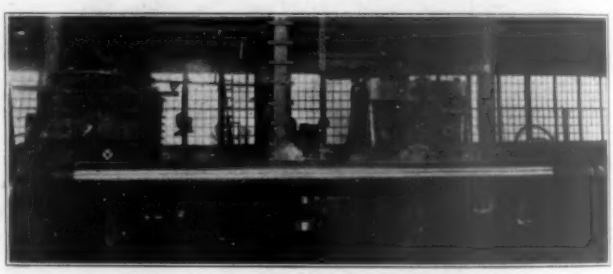
NOTABLE WAR-TIME REPAIR

Of the repair presently to be described, Everett Moses, president of the Welded Products Company, Birmingham, Ala., writes:

Preheating Device in Position

"The proper handling of this work presented engineering problems upon which there was little, if any, available data. While the Emergency Fleet Corporation, for whom the work was done, expressed confidence in the experiment, they could throw no light upon the manner of its accomplishment."

Four bronze sleeves were shrunk on a heavy propeller shaft. It was intended to have the sleeves close enough in series to admit of caulking the joints. On cooling, however, it was found that the sleeves lacked approximately half an inch of butting—a distance too great for effective caulking. The sleeves at either end of the series were of slightly greater



How the Job Looked When Finished

diameter than the two intermediate sleeves, the former being designed to turn in bearings and the latter to serve merely as a protection for the steel shaft where it would otherwise be exposed directly to the corroding influence of salt water in the section between the two bearings.

To have brought the sleeves together by removing and reshrinking them, even if it could have been successfully accomplished, would have involved considerable difficulty and expense; and it seemed more than probable that such an attempt would have resulted in a repetition of the initial failure. For this reason it was decided to experiment with welding. It was not, however, deemed advisable to fill in the spaces by adding metal fused with the blowpipe while the sleeves were frozen to the shaft, as it seemed likely that the weld would pull apart on cooling. The problem, then, became one of applying preheat in a manner that would not result in disalignment of the shaft.

First a special preheating hood was prepared to admit of uniformly heating a single one of the four sleeves. Then one of the sleeves was expanded by preheating the area enclosed in the hood, when the preheated section was welded to the cold sleeve next in series. This process was then applied to the succeeding sections serially, in each instance heating a single sleeve and welding it to the cold sleeve adjoining.

BETTER PRODUCTION OF BUTT WELDS*

PRODUCTION work is the principal use to which all electric resistance welding machinery is adapted. The nature of the process imposes well-understood limitations on its use for repairs. Better production is simply a matter of getting all that should be produced from a given equipment, whether it be a single welder or a battery of them, assuming that the equipment is sufficient to satisfy the demands of the market for the products of the machines. Welding machines are not absolutely "fool proof" in their construction, so lack of improper supervision sometimes results in disappointing the user, who is unable to account for the discrepancies between estimated production and actual production. That these differences are caused by a combination of controllable factors is shown in the accompanying diagram. Here is illustrated a condition that at one time existed in a large plant using many different types of butt-welders. Each of the three main necks shown is due to several causes, which a careful investigation was able to classify so that remedial measures might be adopted and the congested points in the diagram opened.

Fifteen percent reduction due to cracked welds and waste is too high a figure to be tolerated. In this factory the problem had to be handled separately for various departments, owing to the diversity of the product and the methods used. One department was devoted largely to the butt-welding of steel rims. Probably 95 per cent of the failures here were due to what may be termed a "cold weld." Faulty preparation of material was back of this condition. When the stock was cut to length ready for circling, one of its edges was trimmed square and the other left as it came from the mill. Owing to the nature of the profile of the section, the resulting hoop, instead of being a short cylinder, was a truncated cone.

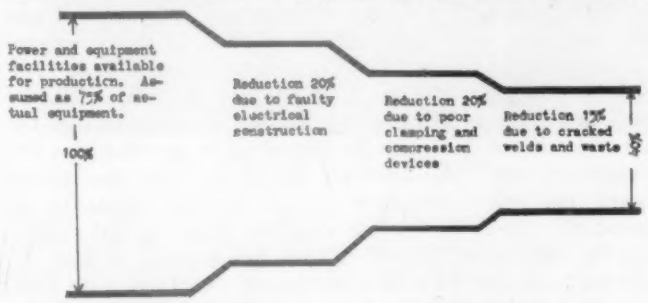
When the hoop thus prepared was clamped in the welder it was invariably found that the abutting edges did not meet squarely, but a V opening was formed, opened on the thin edge of the section sometimes as much as 3-16 inch, depending on the condition of the untrimmed mill edge. Thus the heating due to the flashing did not start uniformly along the whole profile, and owing to the shape of the V, the part of the weld that was to stand the heaviest punishment in the subsequent operation of rolling was not brought up to heat until the very last moment before the compression took place, and, depending on the amount of the material which there was flashed off, might be up to the welding heat or it might not.

The suggestion was made to cut the stock on the bias, so as to provide the extra material to fill the V opening. A short trial showed about 8 per cent reduction of cracked welds, but the suggestion was abandoned on the claim that the rims made in this manner were thrown out of true. Possibly that was the case, because the allowance of cut was too generous. The experiment should have been carried further because, if the hoop having a V opening at the weld resulted in a true rim, no difference should have been produced whether the V opening was filled with air or with a sufficient quantity of iron to help uniform heating.

It should be noted that this condition was aggravated by careless cleaning on the grinder. The mill edge was rusty, and in order to facilitate welding it was ground off. In most cases the thin edge was rounded off, removing as much as 1-8 inch of the material from the point where it was needed most. That is one good example of the importance of the "human equation" in the operation of machinery of this sort. Obviously, the remedies for these "cold welds" are more care in cleaning or possibly shearing both edges on a slight bias, and a little more care on the part of the man operating the welder.

Another cause of cracked welds was heating the work too slowly. An analysis of the electrical characteristics of the welding operations performed at the plant in question showed that the welding currents averaged 15,000 amperes per square inch of the profile welded. The operator was paid by the work he produced and was naturally anxious to get out as much as he could. So, if the machine didn't keep pace with him, there was a tendency to take a chance on compressing before the material had reached a welding temperature. This theory was supported by a study of the results over an extended period, in which the percentage of cracked welds was always materially reduced when the product came from machines capable of fast welding.

Troubles of a different nature were found in a department where the work presented a more concentrated cross-section, because of the unsuitable clamping equipment for the class of


Power and equipment facilities available for production. Assumed as 75% of actual equipment.
100%
Reduction 20% due to faulty electrical construction
Reduction 20% due to poor clamping and compression devices
Reduction 15% due to cracked welds and waste
5%

Graphic Representation of a Production Problem

work it handled. Narrow welding jaws and dies are O. K. where thin stock is clamped. Such stock has a large area in contact with the clamps, and the pressure required for compression is necessarily small, owing to the spread of the material. Hence the possibility of the stock slipping in the jaws during compression is very remote.

However, when it is desired to handle fairly condensed sections, there is less area in contact with the clamping jaws, and the compression force required is greater. Hence slipping occurs and imperfect welding results. This is exactly what happened in the case under discussion. Also, the burrs were carelessly ground in some cases, and this reduced the cross-section at the weld, so that it was not equal to the heavy strain put on it by the expanders. The remedies suggested were more substantial clamping (yet easy to operate because the nature of the work called for rapid production) and more care in the grinding operations.

In a third department investigated the cross-section of the work was considerably larger, and here the main trouble was faulty operation, due to either inexperience or carelessness. When the rim was clamped in position ready for welding the operator closed the switch and at the same time opened the valve controlling hydraulic compression to the extent that caused the platen to move just fast enough to enable the metal to be burned off the edges to be welded at a uniform rate. When a sufficient amount of metal had been burned off he opened the valve fully, admitting full pressure into the cylinders and causing the heated parts to be forced together. Now this first process of flashing is the all-important operation. If the man is inexperienced or careless, his manipula-

From an authorized interview with Edmund J. Henke, president, American Electric Fusion Corporation, Chicago.

tion of the valve equipment is such that the platen moves faster than the metal is capable of being flashed off. As a result, he welds the abutting faces at several points, and his flashing ceases. In order to break up the joint, he must now wait until the sections that are welded on reach the molten state, when he can tear them apart and start the process of flashing all over again. But the damage is done, for there have been formed zones of burned metal, and though he flashes and welds the rims eventually and his mistake is not detected by casual inspection, the expander will find the weakest point in the rim, and the crack results. These operations were clearly illustrated by the records of tests made with a graphic wattmeter. When the rate of advance of the platen was just right, and his welding progressed just rapidly enough with the ability of the machine to supply the welding energy, the weld was finished in one-half the time and was a better weld than the one resulting from advancing the platen too rapidly. It is evident then that the careless way results in poor welding and loss of time and places a far greater strain on the welding equipment than the normal operation would.

Apart from the remedies already discussed, which would materially reduce the production loss, a further improvement was suggested; the elimination of the human equation by substituting a suitable automatic compression device on the machines handling work of larger cross-section. There have been some theories advanced as to the method used by the operator in determining the proper time to squeeze the weld. One of the most common theories is that he "feels" when the metal is "plastic" enough to be forced together. Observations and talks with men who have operated welders for years indicate that this is but a theory. Here is how the work is done. The work is clamped with the welding jaws a certain distance apart, this distance being determined by the allowance of the amount of metal that must be flashed off to get the ends hot enough to weld. The operator begins to move one platen toward the other just fast enough for the metal to be burned off. When he reaches a certain distance, that experience has determined produced ends hot enough to flash, he pulls the lever and the weld is completed. Such being the case, it would be advisable to provide specially constructed valves, which could be adjusted once for all to give the right rate of advance, the operator merely starting the operation and opening the by-pass to admit the full pressure when the time for compression has arrived. Or, in hand operated machines, toggle mechanism could be supplanted by an air operated compression device, which would begin its operation on a reduced air pressure and automatically admit full pressure after a certain lapse of time. Then the quality of the product would be improved, and the second neck of the diagram would be expanded.

Further expansion of second neck in the diagram could be accomplished by proper attention to the clamping devices. Clamping devices that operate right can be further improved by proper attention to details of locking, cooling, etc., and, above all, by developing an air operated clamp. Past experience has shown that such a clamp, in order to be successful, must be mechanically locked during the time of welding, though air operated. In the work that has been discussed above, it was apparent that the real locking of the work during welding was done by nature, owing to the expansion of metal, resulting from highly concentrated heat at the weld. Any clamp that is not mechanically locked that has an elastic backing as an air cushion will not resist sufficiently these forces of expansion so that slipping and poor welding results. Such a development would also result in speeding up production. There is a limit to the brute force which a man can put forth during a day's work, so that even though it takes the same time as hand clamping, the saving of energy would result in shorter welding time, as the man would be in shape to handle the product at an increased rate of cycles. The welding machine and its transformer are unlike any other apparatus both mechanically and electrically. The average electrician of the "wire stringer" type does not appreciate the importance of the condition of contacts and connections of the secondary circuit of the welding machine. Hence, there are losses that go unnoticed because the water cooling is patient and absorbs the excess heat which the trouble develops until the crisis occurs and the apparatus is out of production.

Where several welders are in operation, a maintenance department should be provided for them and placed in charge of a man who understands the nature of them. This man should have at his command proper help and facilities. Maintenance costs would be greatly reduced, and losses due to machines being out of production would be diminished. A maintenance department of this sort might not actually make money the first year, but if the work was properly handled and organized during that time, production would be constantly nearer to normal and would more than repay the effort.

CHICAGO WELDED PRODUCTS BOOTH AT POWER PLANT EXHIBIT

At the Power Plant Equipment and Mechanical Exhibit held at the Municipal Pier, Chicago, June 8-10, under the auspices of the Central States Exhibitors Association in conjunction with the annual Illinois State Convention of the National Association of Stationary Engineers, the Chicago Welded Products Company occupied Booths 1 and 2, displaying electric arc welding and Oxy-Acetylene welding and cutting. The photo-

One of the Best Attended Booths at the Exhibit

graph shows how attractively the booth was decorated, and it was the first exhibit to greet the visitors as they entered the display room. At the right was an arc welder in operation, enclosed by a heavy screen, which was fitted with colored glass windows so that visitors could view the operation without wearing helmets. At the left was a complete oxy-acetylene welding and cutting outfit in operation, and in the center a display of equipment, samples of welded products, and literature. Practical representatives were on hand to answer questions pertaining to the manufacture or repair of boilers, tanks, heavy machinery parts of all metals, pipe lines, etc., by either process.

DISCUSSION OF TORCH TESTS

At the meeting of the American Society of Mechanical Engineers held at the Congress Hotel, Chicago, May 25, R. S. Johnston, of the U. S. Bureau of Standards, read a paper on "An Investigation of Oxy-Acetylene Welding and Cutting Blowpipes." A discussion of the paper, prepared by S. W. Miller, of Rochester, N. Y., was read. Oral discussions were presented by A. S. Kinsey, New York, C. A. McCune, New York, J. I. Banash, Chicago, Stuart Plumley, Chicago, S. V. James, Chicago, and E. Wanamaker, Chicago.

Hints for the Welder

When you finish an interesting piece of work, can you set down on paper the manner in which you went about the job, how you prepared the work and how the job was done? Have you learned some little stunt every welder ought to know? Contributions to this department are paid for. Write it down any old way – I'll polish it up. Make a rough pencil sketch and our draughtsman will fix it up fine. Line drawings are more practical than photographs. Do it today – the men on the firing line are waiting. L. B. Mackenzie, Editor.

WELDING PRESSURE PIPES

By H. C. Speakman

The Coast Culvert and Flume Co., Portland, Ore., have nearly completed a project of a 300 lb. actual working pressure, all welded pipe line, for the Skaget River Power Plant. This line has a length of 890 feet including angles and straight pipe. The straight are built in sections of 20 feet with a diameter of 32 and 30 inches. Each section is composed of four separate cans, five feet long. Girth seams and straight seams are all butted together, leaving a sixteenth opening to prevent overlapping. All our seams are beveled to a 45 angle with the bevel on the inside of the straight seaming. The cans are rolled from 7/16, 3/8 and 1/8 Ingot steel and tacked together with a 7/16, 3/8 and 1/8 butt strap on the out side of straight seams. Thus making approximately 15 feet of straight seaming to be welded on each separate can. We are using a double bead on the 3/8 and 1/8 inside seams with 3/32 and 5/32 electrodes. Taking the inside seam first, we start in the center and weld toward each end, or as our operators prefer; starting about one third of the way in, weld to the end, then back another one third and weld up to the already welded portion, etc. Thus the operator does not have to crawl over hot metal, and also avoids having the tacking break. Our welds are all made a trifle over flush which has a very dressy appearance. The object of our first bead is to burn all the way through, also to prevent the metal from being porous, if a single bead were made. This allows the second to be thoroughly fused with a close arc.

View Showing Pads and Bands on Girth Seams

One of the Curves

Each can, after being welded is assembled into sections (20 ft.), tacked and ready for welding. Steel ring expanders are placed on the inside of each girth seam to keep the pipe in shape, also acting as a backing for the weld. Here too we use the double weld. Starting at any point and going right around, keeping about six inches ahead with the bottom bead. Our two end seams are laced across, the outside with 8—3x2x3/8 straps welded on over top, while the center girth seam has ten straps, all proportioned evenly around. These straps are put on just as soon as the operator has passed the point which he thinks is the right place for it, then going on as before. In this way the strap cools as the seam cools leaving no chance for any unnecessary strains. Each welder is instructed not to start any girth seams unless he has time to go all the way around, because we found that if we did not finish a complete seam leaving it stand over night, there would something be sure to crack, if we started in again on the cold pipe, the next day. Outside welding of girth seams and pads average sixteen feet to a seam.

A Carload of Welded Sections

After the sections are all welded on the outside, the expanders are taken out and a wash weld is then put on the inside, making about twenty six feet on the inside to a section. Totaling up all the footage to a section, we find that we have nearly 135 feet on our straight pipe.

The curves along the pipe are different angles and lengths. All of these are laid out and welded together, with angle iron straps around for anchoring to concrete foundations. Angles are welded both inside and out also using the small straps spaced evenly around. In many cases where the seam is quite wide we use a lace bead; but on the inside we keep it as smooth as possible. The pipe line is provided with two reducing elbows branching from the main pipe by an all welded Y. This Y is of 1/8 metal, welded with double beading both inside and out and is reinforced in the crotch with a heavy six inch strap.

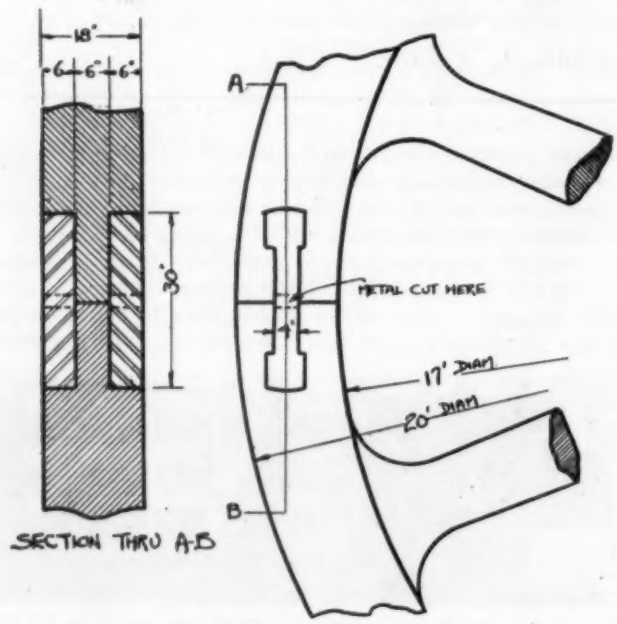
Our scale of footage, that is required is 5½ feet per hour on 7/16, 6½ on 3/8 and 7½ feet on 1/8 metals; but when we are working on straight seams we average much better than that, and have gone as high as 12 feet an hour on 1/8 metal, depositing at that rate 2½ pounds of 1/8 welding wire. On the girth seams it takes from 2½ to 3 hours to do one seam on 7/16 metal and even the lighter metals take nearly as long. Considerable time is lost in moving around, rolling pipe, and spacing the pads. The inside wash weld takes about 2½ or more hours to a section. Thus we find that it requires over twenty hours to fully complete welding a twenty foot section of pipe.

Now we see that this project and other projects of all welded pipe lines require a great amount of welding; and must be handled with considerable ingenuity to contend with unforeseen difficulties. The welding must be handled with skill and knowledge of the operator; to know his right amount of heat, voltage and how to exactly fuse, penetrating every inch of metal.

CUTTING FLYWHEEL LINKS

By A. E. DeBurn

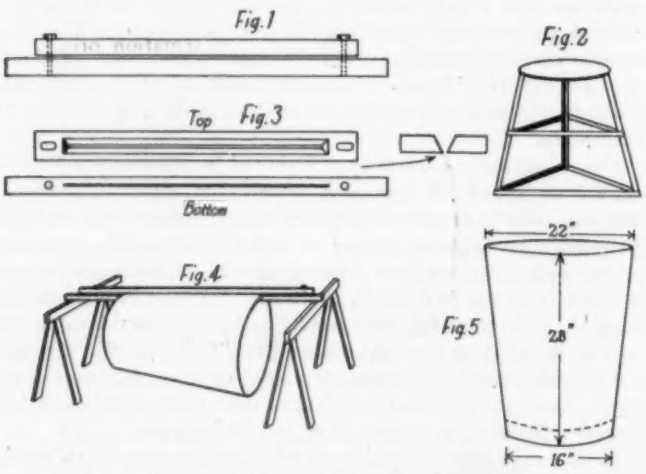
The February, 1921 issue of *The Welding Engineer* prints an article on applications of oxy-acetylene cutting, one interesting part concerning the removal of a set of flywheel links by the cutting process. These links are slight taper fit, and being put in hot they contract longitudinally, pulling the flywheel together and holding themselves in place. Where the gap in the flywheel rim was wide enough I have found it possible to merely heat the link in the center, at point marked



"METAL CUT HERE," with a welding torch, insert a thin chisel bar in the rim gap, and drive out from the back. In the larger, closer fitter flywheels it has never failed me to weld an eye-bolt to the center of the link, the same place where the heat was applied, and when the weld has cooled down so it has sufficient strength to apply a pull to the eye-bolt, at the same time jarring if possible. The heat of the weld will have expanded the link longitudinally and loosened it so it will come out easily, and in the above cases the links can be used again when the wheel is assembled at its new location.

USEFUL JIGS FOR SHEET METAL JOBS

Welding the side and bottom seams of several hundred steel tubs is made considerably easier by the use of simple jigs shown in Figures 1 and 2. They were originally made to use in connection with the welding on tubs and are of such design



Convenient Jigs for Sheet Metal Work

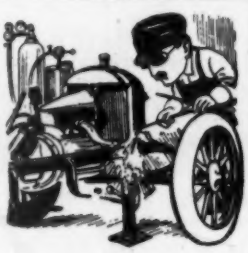
that they will be found useful in a variety of other sheet metal work. The jig illustrated in Figure 1 consists of two heavy bars held together by bolting the ends. Figure 3 shows the deep groove cut in the top bar to allow the torch to work along the seam, with the bolt holes of the top bar slotted to allow for expansion during welding, and a sketch of the cross section of the top bar. The bottom bar has a small shallow groove directly below the center of the opening in the top bar. This allows the welder to secure thorough penetration and is also helpful in overcoming the expansion effects. The stock is put in the jig as shown in Figure 4, and the side seam welded with the torch. Then a bottom is placed on the frame (Fig. 2), the tub thrown over it, and the bottom welded on from the outside. Fig. 5 gives the shape and dimensions of the tubs for which these jigs were made. The second one is of a more special nature, but the first can be used for welding side seams in a great variety of round, square and rectangular sizes.

WARPING I-BEAMS AND ANGLE IRONS

An operator who was called upon to split an old I-beam, eighteen feet long, which had been used for several years in an old boiler house, found that after cutting the beam had warped so much that there was a six inch opening near the center. Another operator had the same difficulty in cutting an inch from one side of a ⅞ in. x 6 in. angle iron. To avoid this warping it is advisable to use as small a preheating flame as possible and to cut fast when the cutting is once started. Or: cut two feet on one end then two feet from the other, returning to the first end and alternating until the cuts meet in the center. Warping results when the metal gets a chance to soak up too much heat during the cutting operation.

TELLS 'EM ABOUT WELDING

Mr. J. Hahn, proprietor of the Charleston Welding Works, Charleston, S. C., goes after the welding business in his locality with some real snappy advertising matter. He has just issued a twelve-page folder, printed in two colors, illustrated by scenes in a welding shop. Expert welding, he tells them, includes not only the knowledge of where to apply the heat, but also just when to stop, because the work can be



THE OXYACETELYNE FLAME

is so hot that it literally melts broken edges of metals together. That is what is meant by welding. If there is a broken part in your auto don't have it riveted or patched. The proper and only thing to do is to bring the car here where the broken parts will be welded as solidly together as they were before the break. It's the only safe way.

WHERE WELDING WORK'S WORTH WHILE

On important sprocket wheels and machine gears, on cams and shafts, on drop-hammers and boiler tubes, on all vital iron and steel work of this character it is essential that the welding be in the hands of master mechanics such as we command. See us about this.

Two Pages from a Welder's Circular

overdone as well as underdone. Another page of the folder calls attention to the fact that the ordinary mechanic cannot be depended upon to turn out a thoroughly lasting, satisfactory piece of welding—it takes a trained, skilled specialist. Two pages of the folder are illustrated here, and may serve as a model for other welders who wish to go out after business this way.

FIXING *the* CHARGE *for the* WELD

By Robt. B. Dyar

DO you charge your customers the RIGHT PRICE for the work you do for them?

Are your charges based on actual FACTS or do you merely guess at them?

Do you know how much of a profit you make on each job that goes through your shop?

Do you know at the end of each month just how much you have made?

Do you ever lose on the jobs on which you make an estimate?

If you do not know accurately just how much each job costs you, you can not make a price that is fair to both you and your customer.

OVERHEAD is known as the cost of running a business The chart (Figure 1) shows most of the items that will ordinarily come under this head in a welding shop although the

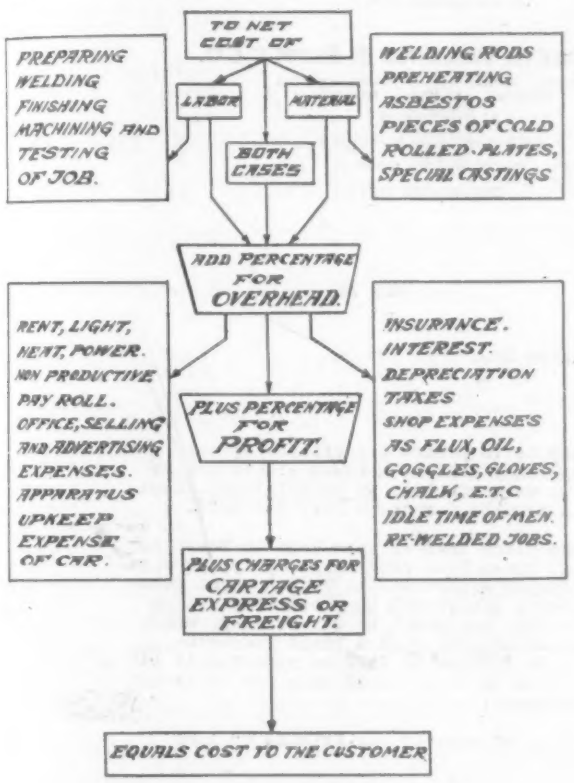

TO NET COST OF
LABOR
MATERIAL
BOTH CASES
PREPARING WELDING FINISHING MACHINING AND TESTING OF JOB.
WELDING RODS PREHEATING ASBESTOS PIECES OF COLD ROLLED PLATES, SPECIAL CASTINGS
ADD PERCENTAGE FOR OVERHEAD.
RENT, LIGHT, HEAT, POWER. NON PRODUCTIVE PAY ROLL. OFFICE, SELLING AND ADVERTISING EXPENSES. APPARATUS UPKEEP EXPENSE OF CAR.
INSURANCE. INTEREST. DEPRECIATION TAXES SHOP EXPENSES AS FLUX, OIL, GOGGLES, GLOVES, CHALK, ETC IDLE TIME OF MEN. RE-WELDED JOBS.
PLUS PERCENTAGE FOR PROFIT.
PLUS CHARGES FOR CARTAGE EXPRESS OR FREIGHT.
EQUALS COST TO THE CUSTOMER

Fig. 1. Chart of Cost Items

items in various shops differ. The lower this figure can be kept, the more profit you will make and the more satisfied customers you will hold.

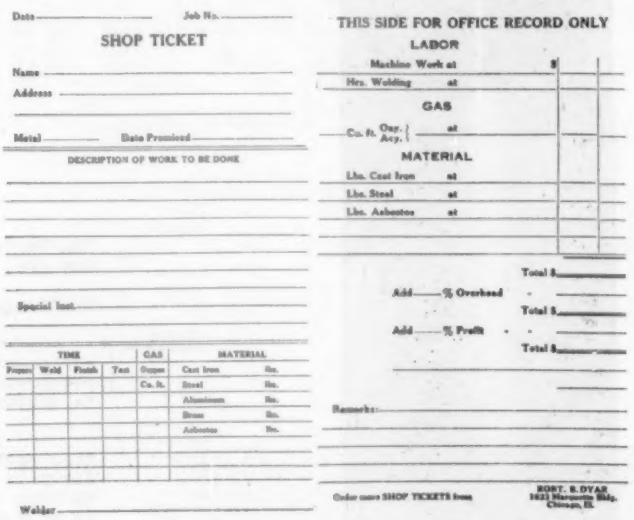
PERCENTAGE of OVERHEAD, is the precentage of the net cost of your business that you must add to this net cost in order to pay the running expenses of the business. In order to properly figure your PERCENTAGE of OVERHEAD, it is necessary to keep an accurate and complete record of the money spent for the items listed on the chart as overhead. If you do not have a system for keeping account of your overhead items it will pay you to get busy and install one.

This percentage can be figured every month, every three months or even every six months or a year. As an example —suppose that the total amount of your overhead items for a period of three months was $1000.00 and for the same period, your net cost for LABOR, GASES and welding MATERIAL was $2000.00, meaning that it cost you $1000.00 to do $2000.00 worth of NET BUSINESS. Your PERCENTAGE of OVERHEAD for that period would then be 50 per cent. In other words you would have to add 50 per cent to your net business in order to take care of the costs of running your business.

From this you can plainly see that the PERCENTAGE of OVERHEAD to be charged is a very important item. If it is to low, you lose money, if too high you overcharge your customers.

As an example of how this works out on a shop ticket such as the one shown in Figure 2, suppose that the total of the net cost column on the back of the ticket was $6.00, meaning that you had used up $6.00 worth of LABOR, GAS and MATERIAL, then if your PERCENTAGE of OVERHEAD was 50 per cent, you would add $3.00 to the $6.00 as the cost of running your business. To the total of $9.00 you would then add your percetnage of profit and charges for cartage or express. The result would be the proper charge to make your customer.

A RIGHT PRICE can not be placed on a welded job unless the correct NET COST is known. A shop ticket will


Date _____ Job No. _____

SHOP TICKET

Name _____

Address _____

Metal _____ Date Promised _____

DESCRIPTION OF WORK TO BE DONE

Special Inst. _____

TIME				GAS	MATERIAL	
Prepar.	Weld	Finish	Test	Oxygen	Cast Iron	lbs.
				Cu. ft.	Steel	lbs.
					Aluminum	lbs.
					Brass	lbs.
					Asbestos	lbs.

Welder _____

THIS SIDE FOR OFFICE RECORD ONLY

LABOR

Machine Work at $

Hrs. Welding at

GAS

Cu. ft. Oxy. / Acy. at

MATERIAL

Lbs. Cast Iron at

Lbs. Steel at

Lbs. Asbestos at

Total $

Add ____% Overhead Total $

Add ____% Profit Total $

Remarks: _____

Order more SHOP TICKETS from ROBT. B. DYAR 1421 Marquette Bldg. Chicago, Ill.

Fig. 2. A Cost Card for Welders

tell you this with the least trouble and will remain a permanent record of every job that goes through your shop.

The shop ticket is a practical application of this chart to your every-day business.

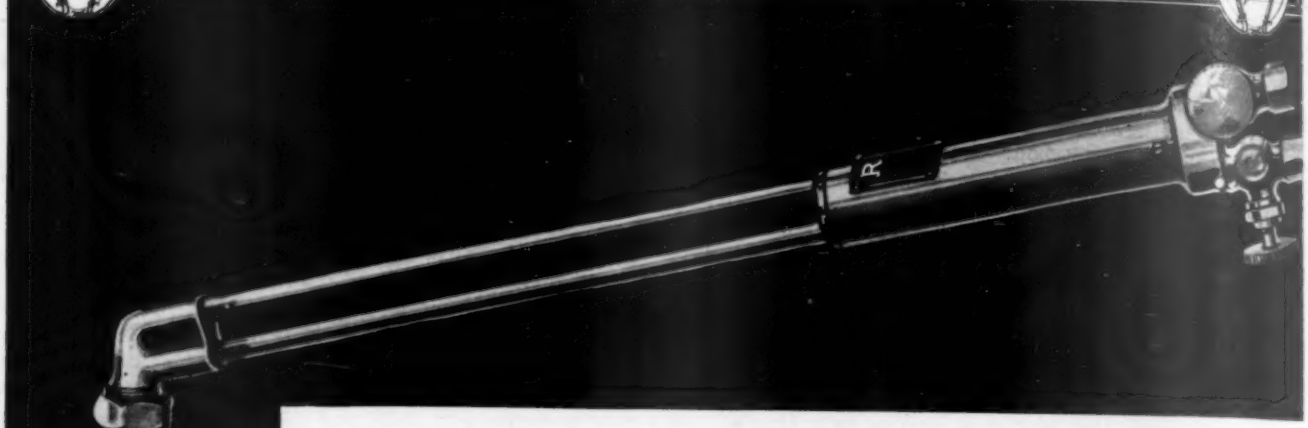
On the front is space for all of the information ordinarily put on shop tickets. In addition to this, there are spaces for the person who welds the job to put down the exact amount of TIME, GASES and welding MATERIAL used.

From the chart you will see that this is the information needed from which to build up the price to be charged your customer. This is done in a very simple manner on the back of the ticket.

LABOR—Under this heading there is a space to put down the total time used for welding (this includes preparing, welding, finishing and testing) and if any machine work has been done, there is a space to put down the hours of machine work. The net cost of this labor, or in other words, the rate per hour of the man is then filled in and the total extended into the net cost column.

GAS—The number of cubic feet of gas is then put down. The welder gets this from the high pressure or tank gauge on the oxygen cylinder. The acetylene consumed is always a little less than the oxygen, but for ordinary purposes the amount of both gases consumed can be figured to be the same, so the cost to be filled in for gas is the combined cost of both

WELDING AND CUTTING APPARATUS



"LET US BE OUR EQUIPMENT DO IT"

THE BUCKEYE WELDING & SUPPLY CO.

ELECTRIC WELDING — OXY-ACETYLENE BRAZING — CARBO-HYDROGEN

ALL REGO GOODS

EQUIPMENT AND SUPPLIES

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CLEVELAND, O.

ZEUS A C ARC WELDERS

SUN-LITE CARBIDE

ACETYLENE GENERATORS,

GASOL

WELDING TORCHES TIPS HOSE TRUCKS GOGGLES C I. ROD STEEL ROD NICKLE STEEL SPELTER BRAZING WIRE ALUMINUM ROD ALUMINUM WIRE BRONZE ROD COPPER ROD

CUTTING TORCHES TIPS HOSE GOGGLES

PREHEATERS OIL ELECTRIC GAS

CARBON AND LEAD BURNING OUTFITS

FLUXES WELDING BRAZING ALUMINUM

May 31, 1921.

The Bastian-Blessing Co.,
Chicago, Ill.

Gentlemen:

Our policy is to assure a purchaser of our equipment and supplies, that he assumes absolutely no responsibility, as we guarantee, NO RESERVATIONS, them to accomplish the results for which they are sold.

During the years that we have been in business this policy has at times been extremely costly, particularly in the equipment department. We had about given up hope of ever being successful in presenting a line of welding and cutting equipment to our friends, which would warrant our continuing such a broad guarantee, when we had the good fortune to have an opportunity to see "REGO" line prove up every claim made for it in our experimental department.

In the words of some of our friends of long standing; Rego is

"The only torch and regulator of today."
"This torch has proven every claim made for it."
"Has Stood the Hardest Test."
"Stick to REGO and Be Happy."

Yours very truly,

THE BUCKEYE WELDING & SUPPLY CO.

SAM/AW

ALL AGREEMENTS ARE CONTINGENT UPON STRIKES, AND OTHER DELAYS UNAVOIDABLE OR BEYOND OUR CONTROL
ALL QUOTATIONS ARE SUBJECT TO ACCEPTANCE BY RETURN MAIL UNLESS OTHERWISE SPECIFIED

THE BASTIAN BLESSING COMPANY
WEST AUSTIN AVENUE AT LA SALLE STREET CHICAGO.

REGO WELDING AND CUTTING APPARATUS REGO

"No Reservations–"

When a firm as well known as the Buckeye Welding & Supply Company makes the statement contained in their letter on the opposite page, it behooves the man in the market for welding and cutting equipment to consider their experience.

They found out that it was extremely costly to make broad guarantees on miscellaneous equipment. It was only after they had found the Rego line that they could make a guarantee without reservations which would not have a "come-back."

Make sure that your welding and cutting equipment bears the Rego mark—thereby insuring yourself minimum trouble and lowest maintenance.

"Facts"

is the title of a booklet recently issued by us which is full of information for those who would make the most of their welding and cutting equipment.

It contains a great deal of interesting data and full color charts showing the right and wrong welding and cutting flames. There is a copy of this booklet for you.

Write for it today

THE BASTIAN BLESSING COMPANY
WEST AUSTIN AVENUE AT LA SALLE STREET CHICAGO.

the oxygen and the acetylene, including the cost of handling the cylinders.

MATERIAL—Such as cast iron, steel, aluminum, brass or tobin bronze (for malleable) filler rods; charcoal, kerosene, oil or city gas used for preheating, asbestos paper and any special castings or pieces of bar stock, plates, etc. The amount of this material is taken from the welder's record. The costs are taken from your invoices and are filled in after each item. The total is then extended to the net cost column.

When this is done, add this column up and the result is the NET COST of your job. To this figure add your percentage for overhead, next add your percentage of profit and if necessary add any charges for CARTAGE, EXPRESS or FREIGHT, and the result is the RIGHT PRICE to charge your customers. A price that is right because it gives you a profit and protects your customer against overcharge.

The permanent detailed record furnished by the shop ticket is valuable as a basis for estimates on future jobs and a check on the time of the welder and on the gases and materials used.

DANGEROUS SCRAP

The scrap dealer who purchases old metal tanks, barrels or cylinders should not fail to ascertain definitely the uses to which such containers have been put. If they have held combustible gases or liquids or even certain dry chemicals they are a serious source of danger.

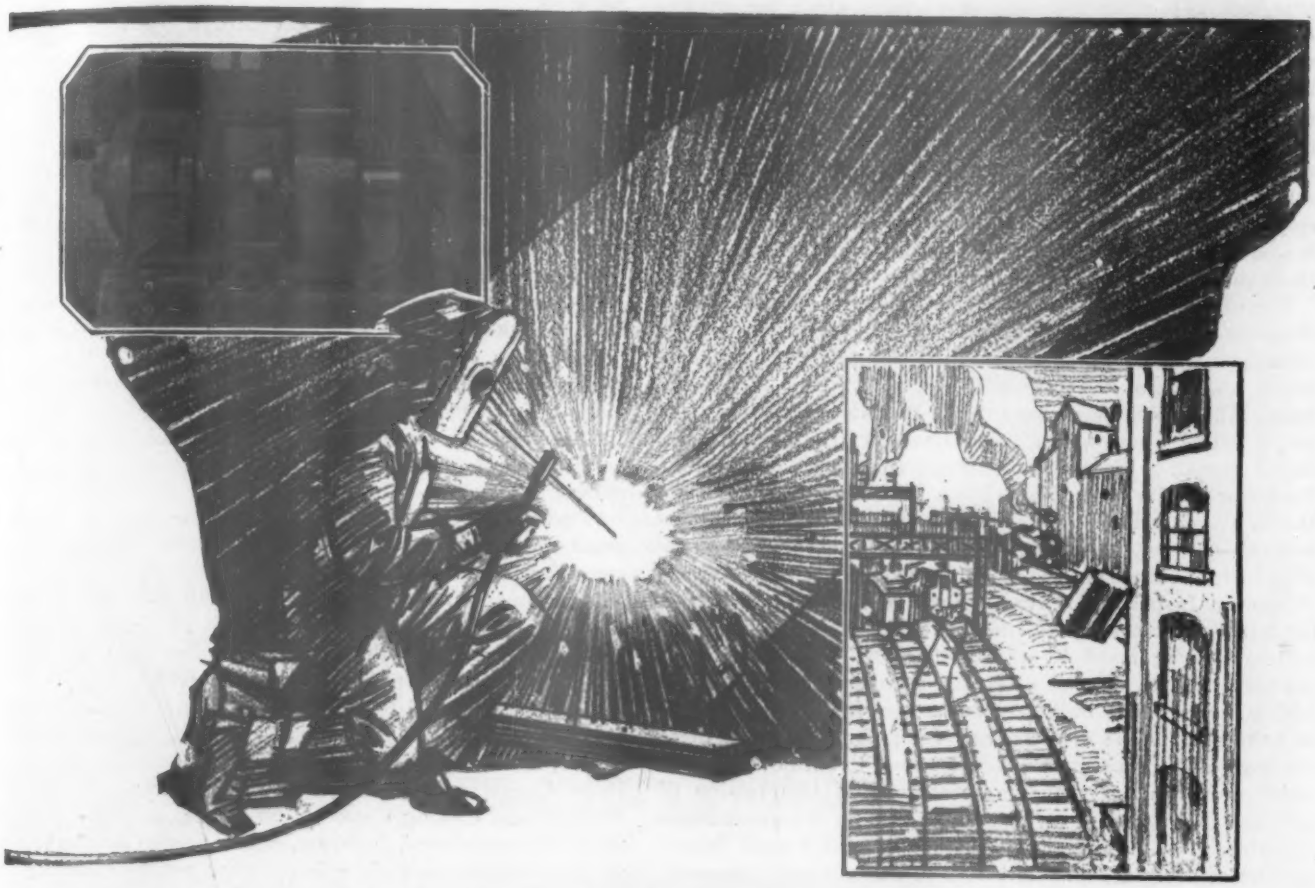
The following case, which is by no means an isolated instance of the kind, illustrates the point. At a certain Ohio scrap yard some weeks ago an explosion resulted in the death of a workman who was cutting bolt holes in a piece of angle iron. In order to make the work accessible he placed it on a sheet steel drum about three feet high by two feet in diameter. Unintentionally, he penetrated the steel sheet of the drum, causing the violent explosion of an unsuspected gas which it contained. Both ends of the drum were blown out, one of the ends and several pieces of angle iron striking the victim of the accident, breaking four of his ribs and puncturing his lungs with fatal effect. An inspection of the drum showed that it had been airtight and had contained a substance resembling sulphur. The dealer stated that he had purchased several of the drums as scrap material some three years previously, and had no idea as to what they had contained.

In many cases the former use of the container may not be suspected, but there are other instances where it should be obvious to a dealer in scrap. For example, everyone engaged in the production of scrap should recognize instantly cylinders used for the storage and transportation of compressed gases. Such cylinders are usually the property of the companies that produce the gases so stored and transported, and their names are generally conspicuously marked on the container in a manner difficult to efface—commonly, by stamping the metal with a die.

Whenever tanks that have been used for explosive gases, liquids or substances are offered for sale as junk, the person offering them should be advised as to their character and warned not to dispose of them for reduction; and the nearest office of the manufacturer, whenever the name is obtainable, should be notified without delay.

Welding in China—Some Views of the Personnel of the China Oxy-Acetylene Welding Works, and of the Work They Are Doing. Their Plant Is at Shanghai

Sometimes the producer is so absorbed with the task of producing, that he overlooks means which might make his plant more productive



A Welded Seam with All the Strength of the Original Metal

Full of oil and sealed tight a tank was dropped from a four-story building onto a railroad track, and nothing but a dent in the tank! A real test of strength, and yet the electric arc welded seam did not leak or show a sign of weakness. Electric welding makes every seam a part of the product itself, rather than a connection which merely holds it together.

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To make electric arc welding a real factor in production, the General Electric Company has developed arc welding equipment for almost every purpose, large and small, suitable for factories where there is enough welding to keep one or many men busy.

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43B-371

ABSTRACT OF RULING OF THE WISCONSIN INDUSTRIAL COMMISSION ON PETITION OF THE ALEXANDER MILBURN COMPANY.

History.

During the Winter of 1919 certain conditions arose in the state of Wisconsin, which resulted in the introduction of a bill in the Legislature of that state to place the manufacture of acetylene gas under the same restrictions which the statutes have placed upon the manufacture of gun powder. This bill would have prevented the manufacture of acetylene within the limits of any incorporated city or village, or within five miles thereof. The bill was withdrawn by the author when it was pointed out that the Wisconsin Industrial Commission had authority to draft orders for the protection of life, health, safety and welfare of employes and frequenters of places of employment, and when the commission gave its promise that it would at once proceed with the preparation of safety orders applicable to acetylene charging plants.

The orders which the commission adopted were prepared in the same manner as all of its other safety orders. An advisory committee was appointed to assist the commission in its work, which was constituted as follows: Julius P. Heil, Heil Company, Milwaukee, Wisconsin; S. J. Williams, secretary, National Safety Council, Chicago, Illinois; P. H. Estes, United States Bureau of Explosives, Chicago, Illinois; O. L. Kowalke, Professor of Chemical Engineering, University of Wisconsin, Madison; W. J. Fairbairn, secretary, Metal Trades and Founders Association, Milwaukee; Frank Ode, representing the Wisconsin Federation of Labor, Milwaukee; J. W. Sullivan, Wisconsin Inspection Bureau, Milwaukee; and M. A. Edgar, the boiler inspector of the Industrial Commission. This committee was organized by the election of Julius P. Heil as chairman and of M. A. Edgar as secretary, and thereafter held many meetings before agreeing upon tentative orders to be submitted to the commission. Invitations to attend these meetings of the committee were addressed to both of the firms which are engaged in the manufacture and compression of acetylene into cylinders for sale other than to the manufacturers in the state of Wisconsin and to the known trade organizations of acetylene manufacturers of the country. The committee devoted much time and careful study to this problem. Seldom, if ever, has this commission had advice and assistance of a more able or more disinterested group of men in drafting any of its safety orders.

The tentative orders which the advisory c ommittee recommended to the commission were submitted to a public hearing which was held at Milwaukee on October 31, 1919. Notices of this hearing and a copy of the tentative orders were sent to every known manufacturer engaged in the compression of acetylene into cylinders for sale other than the manufacturers throughout the country. This public hearing was well attended, and approval of the tentative orders was expressed by all witnesses, except with reference to the order relating to the location of acetylene charging plants, which order is not questioned in this proceeding. As a result of suggestions at the public hearing, a few slight changes were made in the draft of the orders tentatively submitted by the advisory committee and as modified were adopted by the commission on November 4, 1919. They were thereafter duly published in the official state paper and became effective on December 11, 1919. These orders were plainly stated to apply only to the manufacture and compression of acetylene into cylinders for sale or transportation to users other than the manufacturers. They were not intended to apply to the manufacture and compression of acetylene into cylinders on a small scale in industrial plants. The commission, in organizing the advisory committee, assigned to it the general duty of drafting safety orders dealing with the hazards in the manufacture and use of gases of all kinds, but it also asked that the committee make it its first duty to draft safety orders for acetylene charging plants. The following excerpt of orders which were adopted November 4, 1919, relate only to the manufacture and compression of acetylene into cylinders for sale or transportation to users other than the manufacturers:

"Order 4600. 'Compressed': The word compressed is meant to indicate gas pressure in excess of that produced by a head or column of 20 lineal inches of water.

"Order 4635. The carbide to water type of generator shall be used.

"Generator shall be provided with liquid seal safety devices which will prevent an undue pressure in the generator.

Generators having a gas receiving bell as an integral part thereof shall not be used.

"Generators shall be designed to provide a normal working pressure not to exceed twenty lineal inches of water column.

"Every generator shall be plainly marked with the maximum number of cubic feet of gas it is designed to supply per hour. The manufacturer's name and address and the trade name or designating marking of the machine.

"When carbide dust is used, the generator shall be supplied with an agitator which will keep the water in constant circulation in the generator chamber while carbide is being introduced in order to avoid the settling or the formation of large quantities or 'islands' of carbide dust.

"The carbide feeding device shall be so arranged that it will be inoperative when the internal agitating apparatus is not in motion.

"The sludge or discharge valves of the generator shall be piped to the outside of the building, and no open troughs for conveying the residue inside the building shall be permitted.

"On January 7th, 1921, a petition with particular reference to the above sections of orders was filed by the Alexander Milburn Company of Baltimore, and following a public hearing on this petition on January 25th intervening petitions were filed by the Imperial Brass Manufacturing Company, Chicago, Illinois; United States Welding Company, Minneapolis, Minnesota; Smith's Inventions, Incorp., Minneapolis, Minnesota; Dyer Company, Cambridge, Massachusetts; and the K-G Welding and Cutting Company, St. Louis, Missouri. The two firms last mentioned, however, subsequently wrote the commission, withdrawing their intervening petitions, stating that they had been filed under misapprehension that these orders related to the manufacture of acetylene in industrial plants.

"The petition of the Alexander Milburn Company, as well as intervening petitions, raised two issues: (1) Whether fraud was perpetrated upon the advisory committee and the commission by the Union Carbide and Carbon Corporation with reference to the orders relating to the generators which may be used in plants engaged in the manufacture and compression of acetylene into cylinders for sale and transportation to users other than the manufacturer; (2) Whether these orders may be modified to permit of the use of medium pressure generators in such plants without increasing the hazard to the life, health, safety and welfare of employes and frequenters.

"With reference to the first issue the commission found that there had been no fraud perpetrated.

"Upon the issue whether the modifications sought are in the interests of safety, this commission feels obliged to regard as extraneous much of the data which was presented by the petitioners. As has been stated, the orders which are sought to be modified relate only to plants engaged in the manufacture or compressing of acetylene into cylinders for sale or transportation to users other than the manufacturers, that is, to so-called 'central stations,' or 'acetylene charging plants.' They do not apply to generators used in industrial plants, from which the acetylene when generated is piped to various parts of the plant, nor even when such plants compress acetylene into cylinders for use in remote parts of such establishments. In this connection it is significant that, although there are a

(Continued on page 55.)

Consider the INGOT- its physical structure

The gas pockets and blow holes found in typical steel ingots cause seams, laps and non-uniformity of structure in the wire.

PAGE-ARMCO Welding Rods and Electrodes drawn from Armco Ingots are free from such defects.

Consider the uniformity of structure in the Armco Ingot on the left. It means dependable welding rods and electrodes.

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WELDING RODS and ELECTRODES

WELDING A CAST IRON BOILER

Davenport, Iowa.
Saturday.

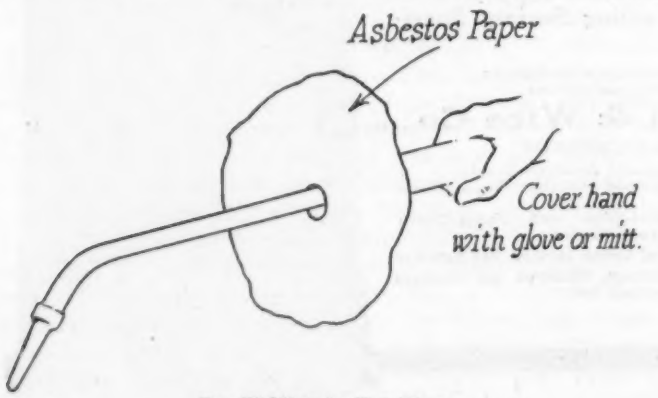
Dear Editor:

It's not writer's cramp or anything like it that's ailing me, but when I told you that I'd have a lot of time on this new job of mine and could sneak around and pick up good ideas in welding for you I simply made a bum guess that's all. They're keeping me busier than a kitten on a tin roof, but today I made it a point to call at Jack's bright and early in hopes that he'd be having a few of his famous cast iron boiler jobs on tap. After I got him fixed up I told him about my new position and asked if he would be having any big fellows today and could I be present. He says sure thing and to come around about four o'clock. Well, I was a little late because some of my customers were busy, but I got back in his shop all right. He was working with a student or a friend, and just as I entered, I heard Jack's bass voice sing out: "Steady, Fred! That's fine. Now let her down easy."

Jack had removed his goggles and was mopping his face with one of his sleeves.

Seeing that he was explaining everything to this other fellow it made it easy for "yours truly." I just jotted down every word they said, thinking that some of the stunts might help you out if you got them just as if they were, first hand.

"I've had my torch on many a furnace section," continued



For Welding in Hot Places

Jack, "but nary a one has been as onery as this fellow; wait a minute I'll give you a hand—Zowie! that chain's hot, toss me over those asbestos mitts and I'll handle her. One more brick and she'll rest jake. Now, let's put in a little more charcoal and we'll rest a bit."

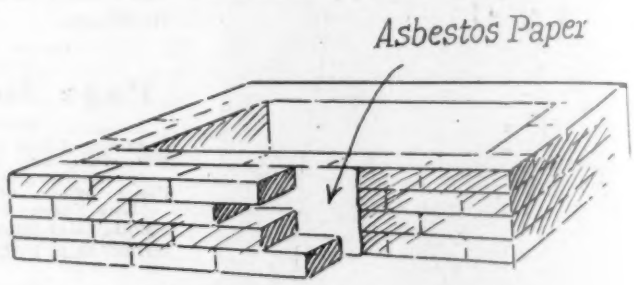
"How about opening a window or two now, will it be all right?" Receiving a nod from Jack Fred proceeded to suit actions to words. As the air started to clear up Fred forked out his pill box, but Jack shook his head. "Count me out, old man! I'm going to stick by the pipe. It may have been O. K. to draw on one of those after sweating blood on a job like this in the 'dark ages,' but since that fellow Volstead came along and turned this country into a second Sahara, I'm not going to dry up my tubes any more than necessary."

After inhaling a few times, Fred asked: "You didn't intend to turn her over when you started, did you?"

"No, not exactly, but you never know what you're going to run into on one of these castings so it's best to play safe. Boiler sections are peculiar things at best and are more or less a gamble all the way through unless a fellow checks up on a few points and then it's about a ninety-nine to a hundred shot that he'll get them the first time. I say first time because there's no earthly need of firing up and going through this procedure a second time if the job is handled right the first time. You probably noticed how fussy I was about you plugging all the openings and getting the air pressure in the section when we were testing her for leaks. Lots of fellows just take a chance and figure that the crack they see, or think they see, is the only one, but when it's too late they find there are others. It only takes a minute to get an air pressure in your section and then take your brush and go over the whole casting with your soapy water. At first we used to test out with the city water pressure, but it was too sloppy and besides if you ever get called out to a small town to do a job you won't have any water pressure to use. Before we got hep to ourselves we had quite a time sealing up the main openings, but you noticed how easy it is now; just two pieces of ⅛-inch sheet rubber packing and two boards just large enough to cover the openings and a clamp. Just about as easy as getting milk to run out of the pail that the old bossie has kicked over.

"Once you get all your leaks located you know at least where to look for your trouble. It's well to clean up around the cracks as much as possible; by that I mean if there is any rust, scale or boiler compound in evidence. Then draw a line around such parts as need welding with ordinary white chalk. It seems to be about the only thing that isn't affected by the heat and a fellow can see it even when metal is red hot."

"Well, if chalk is so good I can't see why you had me chip that crack out," interrupted Fred.



The Asbestos Lining Helps to Retain the Heat

"I told you I was playing safe. Many times chalk may be rubbed off. Then again when your work heats up there are times when your broken ends close up so tight that it's a mighty hard thing to tell where your crack is. It's all right to smile, but I've seen lads weld an inch or two to one side of the break without knowing it at the time and they were pretty fair welders at that. Of course, in establishing an alibi they lead the boss to believe that the metal opened up along beside the weld, but I certainly believe that they really knew what happened although they wouldn't admit it. Chipping is a darn good thing anyway; it may take a little time, but your break will be clean and you can make the weld faster."

"Now, you asked if I wasn't figuring on doing this job without any turning over. I sure was, but when we chipped her out it looked as if the crack stopped at that corner. The torch told a different story; the crack didn't run any further on the outside so that you could see it, but when it melted you could see that 'tell-tale' film of oxide running up from the inside so there is no saying how far we'll have to follow it."

"But, Jack, if it isn't cracked all the way through would there be any harm in letting that side go? It's probably only a foundry check."

"I'll say there would, and that there point is one of the chief troubles a welder has to contend with and most of them don't know it. If the slightest sign of crack is left on the under side, or for that matter any side, your casting is going to open up there if any possibility presents itself and this fact

applies not only to boiler sections, but to all castings being welded. For my part I always think of a pane of glass; if you scratch it with a glass cutter you know where it will break and it's much the same with cast iron. That's why we should always figure on removing all the cracks. It would have been much easier on this particular job to have stopped as you say in the corner, but I'd bet you a dollar to a doughnut that she'd open up in cooling."

"How about a squint at the fire?" asked Fred. "Will she be needing any more charcoal?"

"She sure will; isn't nearly hot enough yet, must of cooled down more than I thought when we turned it. Here, you hold this cover up and I'll shoot in three or four shovelfuls. That ought to fix her. Now, in about five minutes we should be ready to go."

"As I was saying," continued Jack, "a cast iron boiler or section is just about as onery a piece as the average welder will run up against. To start with, all stove or furnace castings are made of very low-grade iron and to make matters worse most of it is overheated and oxidized right in the foundry. When the average welder finds any of these parts walking into his shop, he doesn't exactly mean to receive them with outstretched arms, figuratively speaking, because there seems to be little, if any, real metal to the casting when it is melted. Most welders don't realize this and all they think of is cussing when they get their torch in a piece like this. If they only stopped to figure that a chain is no stronger than its weakest link they'd get along better, since metal is burnt up in casting the piece it can't be so very strong. When some real good cast iron filler rod is used with plenty of flux and 'elbow grease' a bond or union takes place that is stronger at least than the rest of the metal."

"I notice you said 'bond,'" interrupted Fred, wouldn't you call it a 'fusion?'"

"I could never bring myself to see it that way. It is true that we are dealing with cast iron, both in our piece and in the filler rod, but they are so very different that they might just as well be two separate metals. Our filler rod contains the best grade of cast iron and it flows freely, whereas, there seems to be little or no iron in the section, it's mostly oxide and it seems absolutely dead. On this account I usually figure that it's more of an adhesion or cementing together in such jobs. However, the point which interests us is that they hold and I guess that's the principal one after all."

"Say, Jack, I wonder if you could give a fellow the main points to remember of these boiler jobs?"

"Sure thing! First watch your preparations; second, the actual welding; and third, your cooling. These things are all equally important, but perhaps the first covers the most details for under preparation naturally comes testing, marking, setting up and heating. I've given you the dope on testing and marking. The only things to remember in setting up and heating are: See that your work is properly supported so no part can sag. Have it four or six inches above the bottom of the oven and arranged so the part to be welded can be readily reached. When an overhead crane is available build your set up under it. Fire bricks as you see are the only things I use for my ovens. I build them up any way I want, leaving draft holes in the lower layer and plenty of room for my fuel. Sheet iron or asbestos paper serves as the top. Only one layer of charcoal should be used to take the chill off and gradually start the heat. The slower the preheating takes place the better, but it is quite important that the work should reach a bright red heat before the torch is turned on.

"If a fellow has plenty of bricks it is better to make the walls of his oven two layers thick with asbestos paper between them, especially so, if the job is large. I would have done it here only I'm shy of bricks. The double wall with the asbestos between serves two purposes, it holds the heat and at the same time protects the welder.

"So far as the welding is concerned you saw how I did that. You may not have realized just how hard I was working my rod into the casting, but that and the use of plenty of flux is the whole secret. It shouldn't be necessary to add that the whole piece should be kept right in the oven and at a red heat while the welding is going on, but once I came across a lad who removed his work from the oven in order to weld it and he often wondered why he couldn't get the desired results. Sometimes you may have to weld with a short torch and cook your hand a bit, but if you'll slide on a small piece of asbestos paper over the head of your torch so that it rests just in front of your handle, like this, you will be surprised how much heat it stops.

"Just because your torch work is finished is no reason for believing that the weld is complete. The cooling process is a very important step. During the welding the work becomes heated unevenly so it's necessary to add a little more fuel. Then seal up the oven, stopping the draft holes with odd pieces of asbestos paper, object being to hold the heat and let the work cool just as slowly as possible, over night if it can be arranged."

I noticed that Jack was adjusting his goggles and getting ready to finish up his job. Glancing at the time clock I saw that I'd have to wear out a little shoe leather if I was to catch that 6:10 train, so bidding Jack farewell I traveled along.

I'll be hitting a shop in Omaha where they pull some rare stunts. If I get in on any you'll hear from me.

Shep.

WELDED PONTOONS IN RECLAMATION WORK

In reclamation work where pontoons are used as supports for discharge pipe lines extending over water surfaces, the welded steel pontoon has been found well adapted to the requirements, owing to the moderate initial cost, watertightness of the joints and exceptional durability. In most projects where new land is to be built up, the "fill" is usually a considerable distance from dredge and pumps, and some kind of support must be provided for the heavy pipe that carries the water. As the line in such operations is generally set at a slight elevation above the surface of a lake, bay or stream, the pontoon is a convenient form of support.

An interesting example of the use of welded pontoons for work of the kind was afforded when a large Chicago dredge and dock company undertook a reclamation contract in the Great Lakes region some time ago. On this project, for which large "sand suckers" were used, it was necessary to carry a 24-inch discharge pipe across water from the pumps to the fill, and arrangements were made to fabricate 95 steel shell pontoons, each 34 inches in diameter by 45 feet in length.

The material used was 5/16-inch soft annealed steel sheets, cut and rolled to make a tube of the required diameter and 15 feet in length. The edges were carefully matched, clamped and then welded together, the operator starting the weld at one end and continuing until the entire 15-foot section had been welded. One man working eight hours averaged 45 feet of welding.

The pontoons were assembled by welding three of the 15-foot sections end to end and welding in dished end plates. In each 15-foot section a 15-inch hole was cut and a manhole flange welded on. When completed the pontoons were filled with air at 60 pounds pressure and floated. The seams proved in all instances to be watertight, a property they retained throughout their service.

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The Approval of the Consumer

USERS of welding processes, in other words the "ultimate consumers" of welding do not seem to be backward in expressing their approval of the use of autogenous welding in production. Many of them emphasize the importance of welded joints as a factor in improving the quality of the product. A manufacturer of steel office furniture advertises widely the fact that the welded joints of his product made it unbreakable. Another, who makes pipe unions, carefully points out a welded brass seat that cannot work loose on account of changes in temperature. A pipe manufacturer illustrates his method of making T-welds and shows how strongly his joints hold. And a maker of heavy chains displays butt-welded links produced by a special machine which it is claimed makes the weld twenty-five per cent stronger than the rest of the link. In many cases where welded joints are made on a production job the welding required can be handled by a job welding shop on a contract basis, and a job of this kind serves the very useful purpose of keeping the equipment busy when repair work gets light.

Work Accumulating for the Welders.

IN a current editorial the Railway Mechanical Engineer gives the following interesting statistics regarding the present condition of freight cars:

"A few weeks ago, on April 8, a new record for the number of freight cars standing idle was established when the car surplus amounted to 524,219. At the same time the number of bad order cars was about 250,000, so that actually there were 275,000 serviceable cars not in use. Since that time the idle cars have decreased and bad orders have increased. On May 1 the car surplus was 482,076 and the bad order cars 309,971, making the net surplus of serviceable cars 172,105. On May 15 the idle cars had decreased to 450,164 and the bad order cars had increased to 324,969, the difference being only 125,195, or 46,910 less than on May 1. A surplus of 450,000 idle cars may seem ample to take care of any increase in business, but when the actual surplus of serviceable cars is only 125,000 it is time the railroads took notice of the situation. If the demand for cars continues to increase as it did during the first half of May and if the bad orders also increase as fast, the small surplus of serviceable cars will exhausted before July 1 and there will be an actual car shortage with over 350,000 idle cars, but all in bad order.

"It is evident that present conditions cannot be allowed to cotinue. The first step must be to reduce the number of bad order cars. There was a time when 4 per cent of unserviceable cars was regarded as a fair figure. When the ratio rose to 9 per cent in 1919, it was considered very serious and prompt measures were taken to reduce it. On May 15 the per cent of bad order cars was 14.2. If these cars required only minor repairs, they could be placed in service with little delay, but this is not the case. More than two-thirds of the total, 231,690 cars or 10.1 per cent of all the freight cars in the country, require heavy repairs.

"What is to be done to improve conditions? In the first place, the roads must begin at once to repair the bad order cars. The number unfit for service should not be allowed to go any higher. A careful survey of the heavy bad order cars should be made and those that cannot be operated economically should never be repaired."

The repair of so many bad order cars will mean considerble welding, and it cannot be postponed indefinitely as the figures clearly indicate. There is a promise here of a big demand for welding apparatus and operators as soon as wage and rate readjustments begin to show results in the way of increased traffic.

Turning bomb-proofs into tanks

THE steel bomb-proof dug-out covers here shown were purchased from the Government at the close of the war and welded together with the oxy-acetylene torch to form the finest kind of seamless, leak-proof water tanks.

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INTERESTING PROPELLER REPAIR

When the S. S. Trialos limped into Philadelphia some time ago minus one of its propeller blades it was feared the vessel would have to be dry docked. To avoid this expense the following expedient was successfully employed:

By removing everything possible from the after portion of the ship the bow was sufficiently lowered so that water pumped into the hold would accumulate forward. The pumps were then started and as the volume of water increased the burden in the bow, the vessel gradually lifted astern. When the keel angle was such that the center of the propeller shaft cleared the water line 12 inches, one section of the shaft was removed in the shaft alley and the aft section of the shaft

The Actual Cutting Time was Twenty-five Minutes

jacked forward to provide clearance between the rudder post and the shaft end for wedging off the propeller.

Everything went forward as planned until the wedging-off process was attempted, when the hub was found to be so badly frozen to the shaft that it successfully resisted every attempt to budge it. After twelve hours of gruelling effort this mode of procedure was abandoned and an oxy-acetylene welding torch was used in an attempt to heat the hub and loosen it by expansion; but due to the size of the casting and its partial immersion in water, nothing could be accomplished.

Having exhausted the usual expedients in such cases, it was decided to try an entirely new procedure that until within the past year was thought to be impossible, and which even more recently was thought to have but little practical value commercially, viz.: Oxy-acetylene cast iron cutting. The hub was an iron casting, and if this could be cut without injuring the shaft the broken propeller could be removed and a new one shrunk on in its place. At this juncture a welding apparatus salesman was called into consultation and he advised that the cutting could be done very easily by a proper manipulation of the cutting torch. Accordingly a service operator was directed to proceed with the job.

In 25 minutes' actual cutting time a slot 5 inches deep and 32 inches long was made across the hub, leaving about 4 inches of the casting still covering the shaft, when the strain cracked the uncut portion through to the shaft. It is interesting to note that, when the cut had almost reached the opposite side of the hub, the wedges used caused the propeller to jump 2 inches on the shaft, after which removal was a simple matter. From the time the salesman was called until the propeller was actually removed was approximately one hour. Two hundred cubic feet of oxygen and about sixty cubic feet of compressed acetylene were consumed in the operation.

It is believed that this is the first time the torch has been used for this specific purpose, but it is only one of a constantly increasing number of instances that conclusively disprove the early assumption that cast iron cutting is merely an interesting scientific discovery of no particular practical commercial value. It is very rapidly developing a definite field of usefulness in this day of advanced engineering economics.

JERRY AND JIM

By Weldon

IT was right after Decoration day and Jerry was sorter worked up telling about Bell Woods and Saint Mitchell. Jerry was sure some proud of his stripes too and he put it purty strong too Jimmy who had landed in San Tonio fixin' junk an' never a chance to go across.

"Yes, sir," says Jerry, "that sure was some great day when Pershin grabbed my hand and kindo husky like he says so every body hears it, 'Jerry, you are a honor to your country,' an' tells me about me doin' all the risky work right up the front line an' all that, an' every mother's son was lined up an' marchin' an' yellin' for me an' when the general puts the medal on my heart everybody sings, 'It is hot in the old town tonight.'"

"Oh, wait a minute, Jerry," says Jimmy stoppin' him, "don't get so het up, mebby you won't remember all of it, if you talk too fast. You said you was weldin' over there didn't you, Jerry?" asked Jimmy kinder soft an' nice.

"Me weldin'! You are whistlin' right I was weldin'," Jerry shouts. "Lord, man, it was me what standardized the whole bloomin' weldin' over there, I am tellin' you, an' not a soul what knowed a thing an' nothin' at all to do with neither. "Why," says Jerry, "I welded cannons, an' casin' wagons, an' airoplanes, an' every darn thing, frames an' all, on a hundred an' sixty thousan' army trucks. I calls that work, I do, an' that wasn't all neither. It was me what laid out the whole weldin' shebang, too, gas houses an' weldin' shops and apparatuses an' the whole works all the way from the Frenchies' front yard to Santa Monica savvy. An' learnin' seven thousan' paperhangers an' cattle chasers how to weld was a man's job too, let me tell you, not countin' that all we had was old fence wire an' rusty barrel hoops for to weld with."

"Musta been awfully tough," says Jimmy, kindo sympathizin'. "You musta did some job when they gave you that medal, I am guessin'."

"You bet," blustered Jerry, swellin' like a bullfrog, "that was a hot one workin' out the no man's land weldin' a busted steerin' arm on a fifty ton tractor tank an' the bullets flyin' all round me, an' me alone on the outside an' everybody thinkin' I was a sure goner. It had to be done thou, an' Jerry was all there. An' them needin' that tank awfully bad. They never would of gone throu the Busher line, the general was sayin' to me, if they hadn't a been for gettin' that tank agoing so quick, see."

Jimmy had about enough by this time, so he says, "Well, Jerry, you was sure some hero, all right. I was talkin' to your buddy the other day, an' he says you had the beautifullest imagination he ever seen an' as for a welder you peeled more spuds than any K. P. as he ever knowed."

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ELECTRIC ARC CUTTING*

ALTHOUGH it is the common practice to use gas for cutting, yet there are many places where the electric arc can be used advantageously for cutting.

One of the most outstanding examples where a saving would result is that of rivet cutting. Here an outlay of ten or fifteen cents an hour for power and practically no other cost except one man's labor will cut from 100 to 200 rivets per hour at a cost of from ½c to 1c each; a good average being ¾c per rivet.

The arc will also cut the scrap section of a car, boiler or tank into charging size and will eat through sills, channels, or other stiffening members at a rate depending on the thickness, but at the same low cost of power. The arc will cut any metal ferrous or non-ferrous and including cast iron.

The thickness that can be economically eaten through by the arc lies below 4 and 6 inches for straight arc cutting. There is a method of nicking or breaking, however, where electric cutting is efficient for any size. In any scrap pile the majority of the work is economically electric; the heavier sections may be nicked and broken, or cut through with gas.

Other uses of the arc for cutting are cobbles, hot or cold, mold fringe and over-flow of ingot molds and miscellaneous cutting and nicking of scrap ends, and mistakes in rolling, etc. One great attribute of arc cutting is that the arc will cut cast iron, brass, aluminum, in fact all metals.

A wonderful field not yet fully developed, but being worked on industriously, is the substitution of the arc for hand chipping of seams in billets, especially those of complex alloy steels.

The current values necessary for these cutting operations run from 280 to 320 amperes for nicking or seaming with a special electrode, giving off oxygen at the heat of the arc to 450 to 550 amperes for graphite arc nicking, 600 amperes for rivet cutting and 800 to 1,200 amperes for general and heavy cutting. The voltage of the cutting arc runs between 27 and 45, a good average being 37. An interesting feature about variations of current and voltage is that the maximum heat occurs with an arc length just longer than a "sputtering" arc. This fact combined with the fact that the radiation losses is greater with the longer arc, makes it apparent to the operator that as far as maximum speed is concerned, the best arc is a reasonably long one or a reasonably short one, whichever is perferred. The chief point is to have the liberation of energy near the work to be cut up and not to waste it in heating up the atmosphere.

With the exception of nicking, heavy values of current are required and about the only piece of apparatus that can stand up under these heavy values of current and not require special attention under conditions met with around a steel mill, is a transformer. A transformer may be placed in any location, outdoors, or indoors, and will survive in the dust and dirt of a steel mill.

The company putting out this book has spent a great deal of time and money developing a control for a special transformer, so that a short circuit would not draw too heavy current and so that the arc could be controlled at these heavy currents. Not the least of the development was the handle which must protect the operator, hold the electrode and also carry the 1,000 amperes. A small item like the use of pure graphite instead of carbon for electrodes almost spells the difference between success and failure.

It has been found by extensive experience that the maximum wattage and hence maximum heat occurs in cutting as well as welding at the shortest arc which is not sputtery. This can also be seen by the fact that with a long arc the heat goes more to heat up the atmosphere than to melt away the metal. This proper arc length determines the voltage of the arc. The only other way, therefore, of increasing the heat is by increasing the current. Judgment must here be used, however. Increase of current means larger electrodes and hence more metal to be cut out, which unless the piece is thin enough say ½-inch to ⅝-inch so that it can be cut from the top only; this cutting out of more material on thick work sometimes defeats the speed gained from the increase of heat, and a compromise must be effected. The latest development for this work is a low resistance graphite and the size popular for various current densities are about as follows: 200 amperes, ¼ to ⅜-inch electrodes; 300 to 400 amperes, ⅜ to ½-inch electrodes; 400 to 600 amperes, ½ to ⅝-inch electrodes; 600 to 800 amperes, ⅝ to ¾-inch electrodes; 800 to 1,200 amperes, ⅝ to 1-inch electrodes with probably ⅞ at 1,000 amperes.

For rivet cutting, due to its more intermittent character, the minimum size electrodes can be used. For instance ½ to ⅝-inch electrodes for 600 amperes can be used. Of course the handle has a whole lot to do with keeping the electrode from getting white hot and oxidizing, and as stated in a previous paragraph much development has been done along this line. A very simple arrangement and a great help is to say, with a 12-inch electrode have it placed in the jaws so about 3 inches protrude from one end and 8 inches from the other, and use the short end and as it points and burns off keep pushing the cool and unused end through the jaw. Another way to keep the ends cool is to grab the electrode in the middle and use it from either end alternately allowing the other end to cool. It is useless to have any more of the electrode than is absolutely needed to reach the work being heated white hot by the current passing through it as this heat in the electrode is wasted and causes harm by burning up by oxidation the cutting rod. It will soon be noted by the operator that the used end points itself admirably for cutting especially on alternating current even if there is no point made to start. Complete explanation of this phenomenon is hard to provide but the fact remains that it so acts. In cutting rivets a slight rotary motion with a wrist fling when the head becomes molten seems to be the most successful manner to accomplish production. In cutting rivets only the first one must be reached for blind. As soon as the rod becomes white hot there is enough illumination to see through the mask to locate subsequent consecutive rivets, and if it is undesirable to touch the sheet to locate the first rivet if the sheet is to be used over again the rod end can be made white hot by an arc from some adjacent heavy part of a deliberately provided piece of scrap metal for that purpose. In cutting rivets where the sheet is to be used over again naturally the arc should not be drawn from the sheet itself and the operator will note that this is easily accomplished, the paint or rust on the sheet preventing the arc from ever jumping from the rivets to it unless it is deliberately coaxed over to the sheet by mislocation of the electrode. Of course the rivet head is generally painted and rusted or both but here a scratch at the end of the rod will start things going, and if such contact is made the arc will not burn the sheet.

Cutting on heavy sections especially is generally best accomplished from the underneath side or from a vertical face tipped slightly greater than 90 degrees so that the molten metal can flow away, although the action is not entirely simply melting metal but oxidizing from the ozone of the arc which free oxygen assists in cutting yet the molten metal must be allowed a sluiceway to pass through or it will solidify and it is harder to cut through this slag metal than through original good metal. The piece can be stood up or tipped to the proper angle or a start for the cutting can be chosen so that the sluice-way is always kept open. In the cutting of cast iron especially this is easily accomplished. In cutting with the electric arc a reasonably smooth surface can be made by paying attention to one side only, or the cutting may be made rough and trimmed up reasonably smooth by a second application of the arc.

**Instruction from the handbook of the Electric Arc Cutting & Welding Co., 152 Jelliff Ave., Newark, N. J. Copies of the complete instruction book may be had from this company at* $1.25 *each.*

There has been developed recently a special electrode for cutting by the electric arc and for such purposes as piercing holes. This spuecial electrode covered with a coating giving off free oxygen under temperature of the arc gasifies the entire steel melted so that the boring action is uninterrupted after once started. This electrode is used by starting the arc and immediately pushing the electrode into the puddle with a mild pressure such as by the weight of the hand. After the hole is through the piece it can be wideneded to any size or shape desired by drawing the arc around its edges. Cutting can be done with this electrode in the same manner as hole boring by proceeding in a line or following the design desired. This type of cutting only takes between 250 and 350 amperes, and hence is especially useful in connection with welding. Where there is a combination cutting and welding machine supplied, i. e., one that will give up 200 or 350 amperes for instance, heavy sections can be welded top and bottom at a point approximately the center of a desired "V" or "X" to be cut out as shown in instructions 10; then the "V" or "X" can be cut out by the electric arc using this special electrode keeping clear of the welding points so that the piece is held in its original lignment. Another method is to temporarily weld one side of a job then cut out the other side by the electric arc, weld that side permanently, then cut out the other side in the temporary weld and weld it permanently.

Refer to the illustrations. Where the piece it not too thick the cut can be made from the top down or horizontally from either edge. The cutting is done by moving the electrode across the thickness of the work with a slow movement downwards, flowing the melted puddle out of the trough and with a quick movement backwards, starting down rapidly so as not to allow the metal to cool off. With this method the piece must not be so thick but that it can be kept flowing.

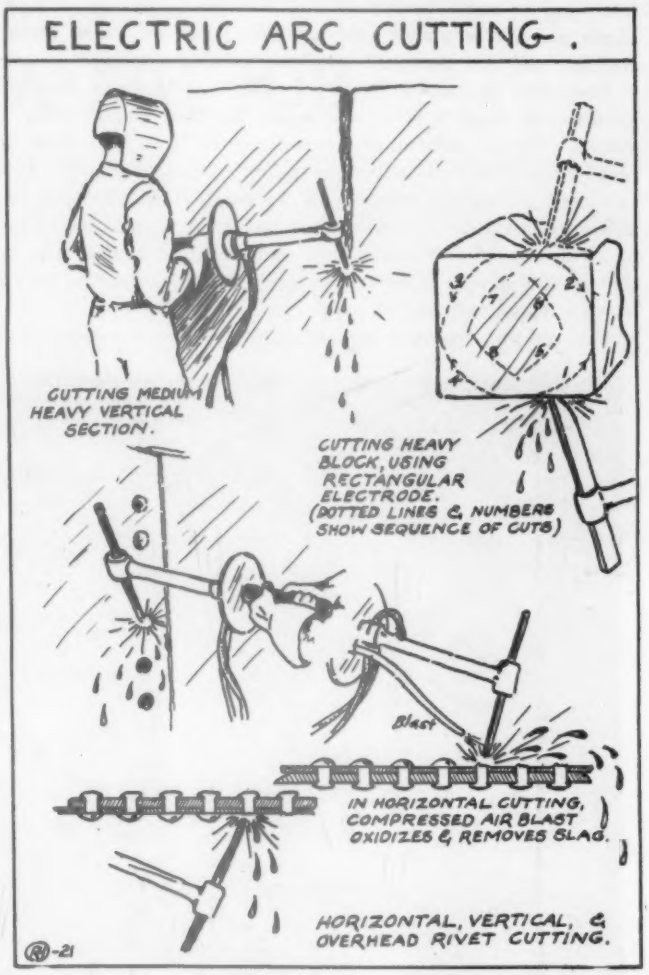
Where the piece is so thick that this method cannot be followed, successive "bites" must be taken off the corners until the piece becomes thin enough to eat clear through. For instance, referring to the right hand illustration. If a good "bite" is taken off in the sequence shown a free trough will always be kept clear for the molten metal to flow away.

A great aid to cutting is the use of a rectangular electrode which has the carrying capacity of a great deal larger round electrode and greatly reduces the width of cut and hence the amount of metal to be removed per cut. An electrode either round or square which contains a cored center of oxidizing chemicals greatly assists the cutting operation in making the metal more fluid and in burning some of the metal up as a gas. These cored cutting electrodes are being brought out in rectangular shape as well as round.

One of the most outstanding examples where arc cutting is economical is the cutting of rivet heads for the replacement of sheets or angles in cars, boilers, ship bottoms, etc. Here an outlay of 10 to 15 cents per hour will result with just one man's labor in between 100 and 200 rivet heads being cut off. The process as shown by the illustration is very simple: The arc is drawn from the rivet head and because the sheet is generally painted or rusted or both, the arc has no tendency to draw to the sheet and the head can be completely cut off, even below the sheet level without the sheet being damaged. When cutting from the vertical or under side, the rivet head melted by the arc flows naturally away, but when cutting on the top horizontally, the molten metal must be pushed aside before solidifying. This is easily and cheaply accomplished with a compressed air jet operated by trigger valve located on or near the cutting handle.

In fact, a handle has been brought out which has this air jet feature an intregal part. The compressed air by combining mechanical action and oxydizing action removes the molten metal and slag at the pull of the trigger after the arc has melted the rivet head. Pressure of 50 to 100 pounds gives best satisfaction. Oxygen may be used for extra fine work, but in general, air is more economical.

This use of the arc for rivet cutting is the best method yet devised, having none of the disadvantages or danger of the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CUTTING HEAVY BLOCK, USING RECTANGULAR ELECTRODE. (DOTTED LINES & NUMBERS SHOW SEQUENCE OF CUTS)
Blast
IN HORIZONTAL CUTTING, COMPRESSED AIR BLAST OXIDIZES & REMOVES SLAG.
HORIZONTAL, VERTICAL, & OVERHEAD RIVET CUTTING.
-21

rivet busting gun and does not cut the edge of the sheet, as does the gas torch, and the electric arc method is a great deal more economical, all things considered than either of the other two processes.

A fire, April 19, partially destroyed the works of the Bottineau Machine & Welding Works, Bottineau, N. D. It is reported that the plant will soon be rebuilt.

The Union Carbide & Carbon Co., 30 East Forty-second Street, New York, manufacturers of carbon electrodes for electric furnaces, welding apparatus, etc., has arranged for a consolidation of its research laboratories at Long Island City. Property, 200 by 600 feet, has been leased and will be equipped for electrical, mechanical, chemical and physical research work. The different interests to be represented at the new plant will include the electro Metallurgical Co., and Union Carbide Co., both of Niagara Falls, N. Y.; the National Carbon Co., and the Linde Air Products Co., Buffalo; and the Prest-O-Lite Co., Indianapolis.

A branch welding plant is to be opened at Spirit Lake, Iowa, by the Spencer Welding Works, Spencer, Iowa.

On June 15 the office of *The Welding Engineer* moved from Room 511, Transportation Bldg., 608 S. Dearborn St., Chicago, to Room 723 in the same building.

THE "ALL WELDED" SHOP

IN this shop, which is located at Kalamazoo, Mich., oxygen and acetylene and the oxy-acetylene welding torch have been put to such diversified and extensive use that, although there are a few places where welding has not been utilized, the title of "All Welded" can be generally applied.

The shop is owned by the Insulating Products Co. The product of this firm is insulating material made from the glassy, fibrous substance formed when jets of steam are played upon molten shale limestone. "Mineral wool," as this substance is called, consists of numberless fibres, each fibre a tiny glass tube. It is adaptable to insulating purposes owing to its ability to withstand high temperatures, and to the fact that in the course of preparation for use a vacuum is created in each tiny tube of the wool.

A shredding machine which shreds and cleans the wool, a

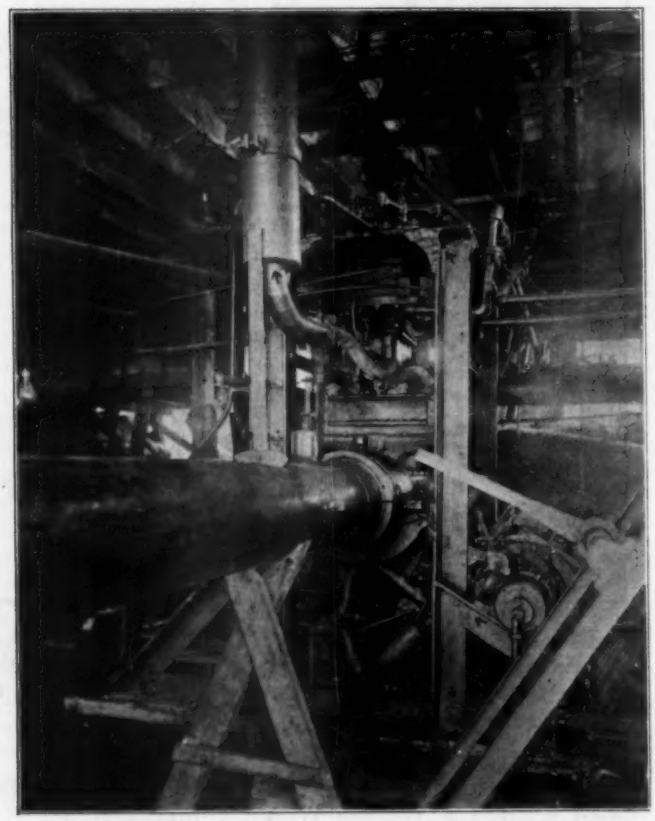

Fig. 1. Automatic Felting Machine Constructed by Oxy-Acetylene Welding

huge trough in which are mixed the wool and its binding liquid, tanks to hold this mixture, the machine that felts the products, and special ovens for drying out the excess moisture —these form the chief units of equipment in the operation of the Insulating Products Co.'s plant.

The automatic felting machine (Fig. 1) is the most important element in the shop, and on this has been done the greatest amount of welding. The frame of the automatic felter was constructed entirely by welding. This was done to meet the excessive vibration to which the machine is subjected. A bolted machine had been made prior to the welded one, but had not proved successful.

In making the frame of the new felter, the base was welded first, angles 6x6x⅞ inches being used. Then the uprights were welded in place and following this operation the job was turned over and the top member welded on. Upon the completion of the frame, it was found that the members had been accurately welded. One upright was a little too high and it was shortened with the torch.

The bearing housings (Fig. 2) were welded to the side members of the frame. These housings, one of which is on each side of the frame, weigh 3,600 pounds when loaded. Despite this weight and the vibration of the machine when it is in operation, the bearings have held firm, tribute to

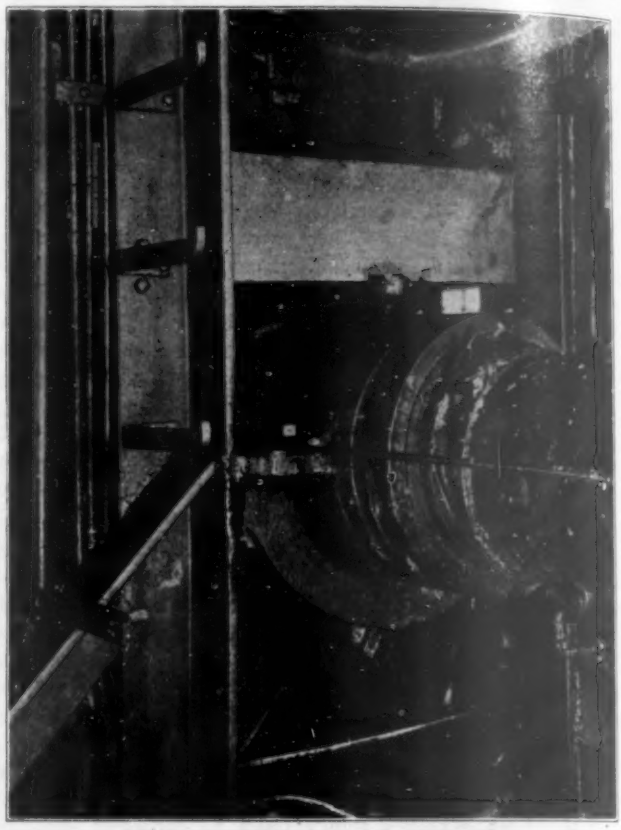

Fig. 2. Main Bearing Welded to Frame

the strength of the welds holding them to the frame. The bearings were machined before being welded and upon completion of the job were found to be in accurate alignment.

In casting the main shaft running on the bearings referred

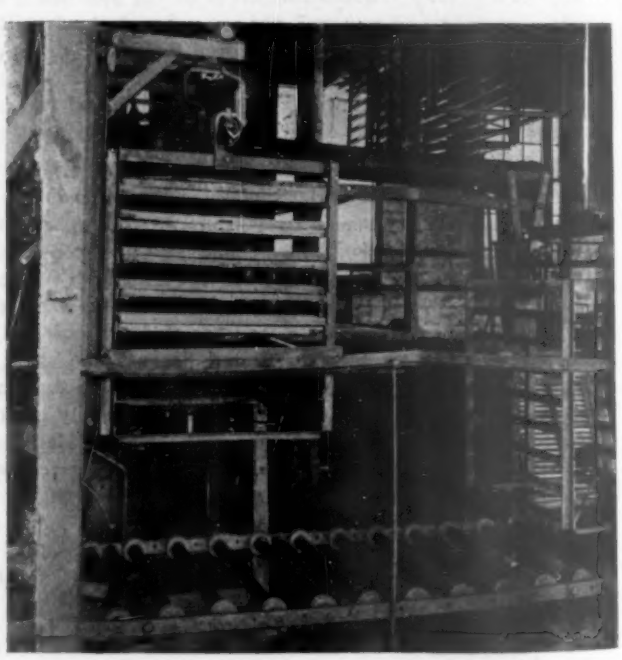

Fig. 3. Welded Cars Used to Convey Materials to Ovens

to above, more or less difficulty was experienced, owing to the tendency of the casting to develop shrinkage cracks as it cooled in the foundry. So after two unsuccessful attempts

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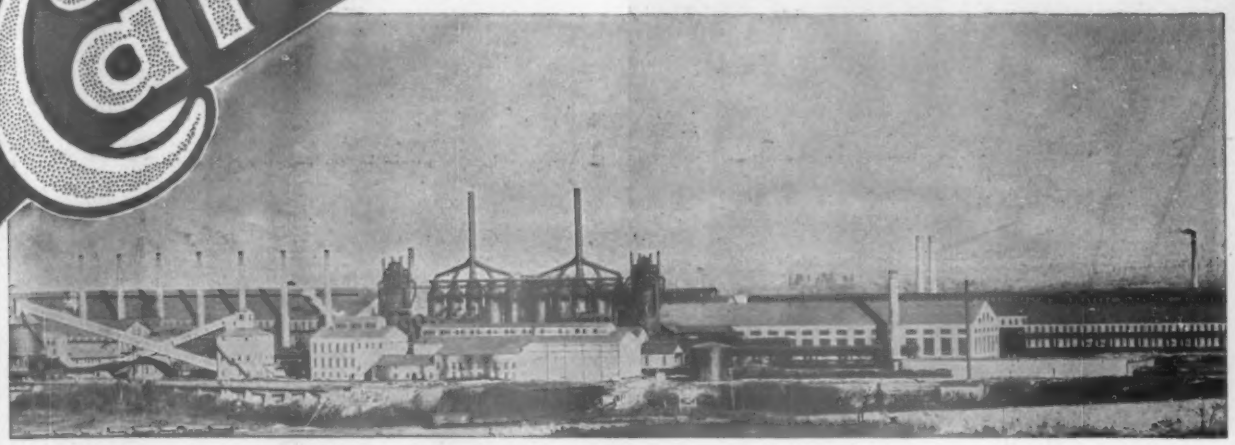

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had been made, the shaft was ordered cast in two sections. The sections were welded together, and the entire shaft then machined.

In addition to the welding operations referred to above, the oxy-acetylene torch was used in building the apparatus which grasps the pads of insulating material coming from the ma-

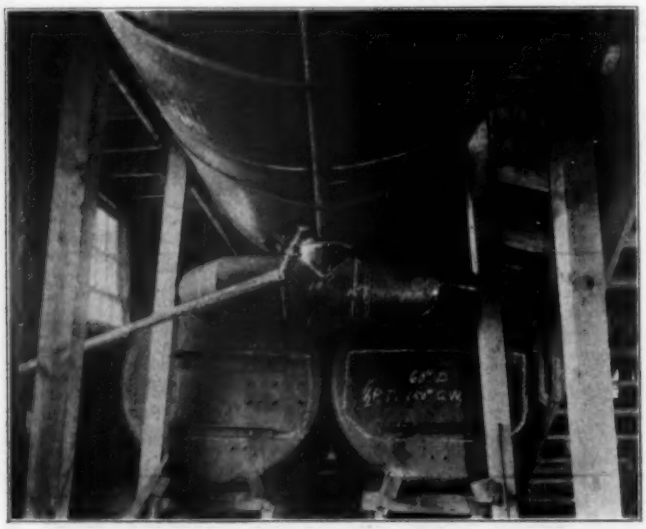

Fig. 4. Mixing Troughs and Tanks

chine and carries them to little cars. which in turn convey the material to the drying ovens. This equipment is shown in Fig. 3.

A brief description of the machine at this time will be of interest.

As stated above it is entirely automatic, being run by compressed air. In operation, the mixture of wool and water and binding material coming from the tanks (Fig. 4) enters valves on the top of the machine. After the machine is charged compressed air is admitted, blowing some of the water out. The material is then forced under pressure against

Fig. 5. Mixing Troughs—All Seams and Pipes Were Welded

a wire screen and undergoes a felting action. There are three such screens or formers mounted on a turret. The product leaves the former, in the shape of a pad, is thrown on a receiving tray, which in turn is carried to the little car. Every operation is automatic, successive pads being carried to the car until it is filled, after which an elevating device carries it over to the track leading to the oven.

The two tanks shown in Fig. 4 were oxy-acetylene welded at the points indicated. The mixing trough shown in Fig. 5 also was welded. The most interesting feature of the welding operation on this trough was the pipe running along the bottom. This pipe contains a series of holes which permit the air to enter the bottom of the trough and agitate the mixture.

All the pipes in the plant were welded. In equipping the ovens with the heating system, 2-inch boiler tubes were used (Fig. 6). These contain oil, heated to 400 degrees F., which

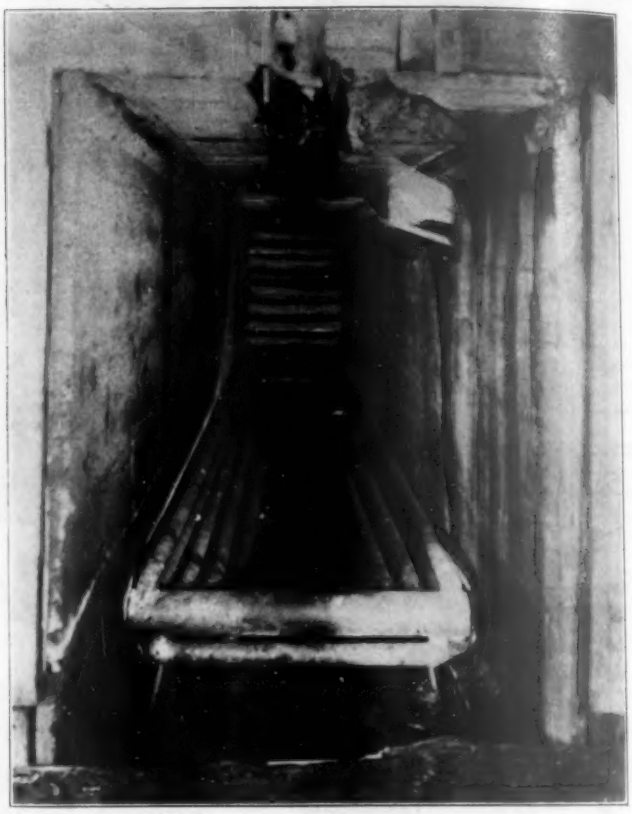

Fig. 6. Drying Ovens—The Piping in This Oven Has 124 Welded Joints

circulates around the furnace. There are nine lengths of tubing, each 93 feet long, in each oven. The piping in each tunnel contains 124 welded joints, made in less than two and a half days by one welder and two helpers.

All the welding in the shop was done by one man, Mr. F. C.

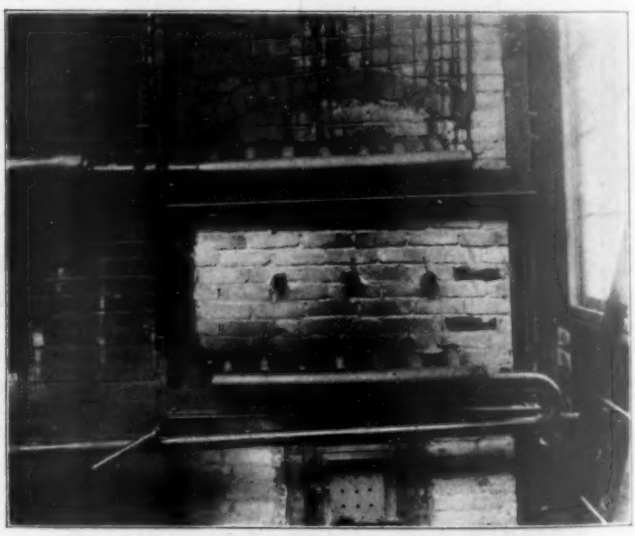

Fig. 7. Welded Manifolds in the Heating System

Emrick, the designer and builder of the automatic felter. No record has been kept of the total time, gas consumption, etc., required for the work, and no attempt therefore has been made in this article to give a detailed description of each welding operation.

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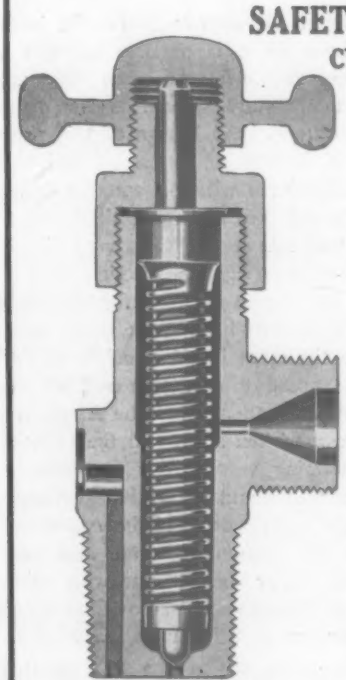

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"THERMIT WELDING" *

By H. D. Kelley †

INASMUCH as Thermit is responsible to Aluminum for its existence, it will be in order to say a few words regarding Aluminum. Aluminum is one of the most widely distributed metallic elements of the earth's surface. Like the majority of other metals, it is found in nature in combination with oxygen. In the case of Aluminum, however, the affinity for oxygen is extremely high. So much so in fact, that it took many years of experimental research to discover a means of disassociating these two elements so as to obtain pure Aluminum on a commercial basis. This reduction was finally accomplished, however, by the electric furnace process back about the year 1880, almost simultaneously by Heroult in France and Hall in America. Since that time the process has been developed to a high point of efficiency so that technically pure Aluminum can now be obtained by the consumer in large quantities at a reasonable price.

This high affinity of Aluminum for oxygen forms the basis of the so-called Thermit Process, as it is possible to start a chemical reaction between these two elements when they are treated to a sufficiently high temperature. Chemists for many years since Aluminum was discovered, have known of this reaction and experimented with it in the reduction of different oxides; mixing finely divided Aluminum with the metallic oxide, placing the mass in the crucible and then heating until the reaction took place. It was found that this resulted in a very violent reaction, practically an explosion, so that the reaction was of no commercial value. It was subsequently discovered that this reaction could be controlled if instead of heating the entire mass the heat were to be applied to the mass in the crucible at one spot, the reaction would then spread through the rest of the mixture and at the end of the reaction there would be Aluminum oxide or slag floating on top in a molten state, and the reduced metal at the bottom of a containing vessel. The first experiments were made with Chromium oxide and finely divided Aluminum. This reaction was entirely satisfactory and the Aluminum combined with the oxygen in the Chromium oxide and pure Chromium metal was produced. Later experiments with other oxides succeeded in producing Manganese, Ferro Chromium, Molybdenum, Ferro Titanium, and many other metals and alloys.

This so-called Alumino-Thermic Process of reducing metallic oxides has since been developed to a high point of efficiency so that it is possible to produce on a commercial basis, metals which are chemically free from carbon. We are regularly producing a number of carbon-free metals by the process.

Among other oxides experimented with was iron oxide. It was found that this reaction not only produced a very pure low carbon steel, but that the heat of this reaction was extremely high, about 5,000 degrees F. It was decided that this intense heat produced so quickly and easily could be used in many ways for welding purposes and the Thermit Process of Welding, which is now so widely known throughout the world, is the result.

This briefly covers the history of the Alumino-Thermic Process of the reduction of metallic oxides and leads up to the subject of the paper, "Thermit Welding."

The underlying principle of the Thermit Process is the high chemical affinity of Aluminum for oxygen. Up to a temperature of 2,800 degrees F. Thermit is an inert mixture. At that temperature, however, the Aluminum unites with the oxygen of the iron oxide and the iron is set free and comes down as a highly superheated liquid steel at a temperature of approximately 5,000 degrees F. or about twice as hot as ordinary molten steel. It is obvious that if steel at this temperature is poured around the sections to be united, especially if the sections have previously been preheated to a bright red heat, it will melt these sections and amalgamate with them so that the whole will cool to form a single homogeneous mass, or in other words, a fusion weld. There are three kinds of Thermit produced for welding ferrous metals, i. e., Plain Thermit, Railroad Thermit and Cast Iron Thermit.

Plain Thermit is a mixture of finely divided Aluminum and Iron Oxide, being used in making pipe welds and welding necks on mill rolls and pinions, where the Thermit is merely used as a heating agent to bring the pipe ends up to a welding temperature and roll and pinion ends to a molten state.

Railroad Thermit is Plain Thermit with the addition of ⅝ per cent Nickel, 1 per cent Manganese and 15 per cent mild steel punchings. This grade of Thermit is used in connection with all wrought iron and steel welds.

Cast Iron Thermit is Plain Thermit with an addition of 3 per cent Ferro Silicon and 20 per cent mild steel punchings. This grade of Thermit is used for welding cast iron parts together.

In making a Thermit weld, the parts to be united are first cleaned off and lined up with a space between the ends to be welded, the extent of which depends upon the size of the section to be welded.

A wax pattern is then formed around the ends to be united, the exact shape of the reinforcement of Thermit steel which

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**Paper read before the American Welding Society, Pittsburgh Section, May 20, 1921.*

†District Manager, Metal and Thermit Corporation.

QUALITY

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The Economical Way to Buy Acetylene?
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Acetylene supplied in portable cylinders of the following sizes and capacities:

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Boston, Mass.
Bound Brook, N. J.
San Francisco, Calif.

is to be cast at that point to make the weld. A sand mold is next rammed around the wax patern and inside a sheet iron box, provision being made in the mold for the necessary number of pouring gates, heating gates, and risers, the risers communicating with the highest point of the wax pattern and the heating and pouring gates with the lowest point. Mold is then vented thoroughly, some of the vent running below bottom of weld. The vent holes are to allow gases to escape after Thermit steel is poured in mold. A basin should be made in top of mold to catch the slag, not allowing the slag to overflow mold and spilling on floor, possibly doing damage. The flame of a compressed air kerosene pre-heater is directed into the heating gate; melts the wax pattern and leaves a space between and around the ends to be welded to be later occupied by the Thermit steel. The heat is continued until the parts to be united have been brought to a red heat. By that time the mold will have become dried out. In the meantime the charge of Thermit is placed in a conical shaped sheet steel crucible lined with Magnesite, supported over the pouring gate of the mold. When sections are red hot, the application of heat is discontinued, the heating gate plugged up and the Thermit charge in the crucible ignited. In from thirty-five to sixty seconds the Thermit reaction is completed and the Thermit steel tapped from the bottom of the crucible into the mold in bulk where it flows around and between the sections to be welded, uniting them into one homogeneous mass.

The slag does not enter the mold but overflows into the mold basin, so that it does not interfere with the welding operation. The amount of Thermit required for a given weld is readily determined from the weight of wax in the pattern. Each pound of wax in the pattern calls for one bag of Thermit, 25 pounds.

It will be seen that the process is a simple one and that the only outside power required is a supply of compressed air for the operation of the pre-heater. The outfit is entirely portable and in many cases, sections of very large size are welded without removal from their position and therefore, at a great saving in time and expense over obtaining new parts. Furthermore, the process permits of fusing a collar or reinforcement of steel all around the welded part, this increasing the cross section at that point and making it stronger than it was originally.

Fields of application in which the Thermit process of welding is being employed extensively at the present time are:

Locomotive Repairs.	Steel Mill Repairs.
Marine Repairs.	Pipe Welding.
Crankshaft Repairs.	Rail Welding.

Steam railroads represent a broad field in repairing locomotives, for the Thermit Process. Practically all the railroads of consequence in the United States, Canada and Mexico use Thermit.

Thermit welding is used extensively in the marine field for welding broken parts. Here the process results in even greater economy than in the case of locomotive repairs owing to the fact that dry dockage is extremely costly and every day saved means hundreds and thousands of dollars. Such repairs are usually executed by contract and seldom keep the vessel in dry dock more than forty-eight hours. The United States navy was one of the first to appreciate the advantage of the process and has used it very extensively at its various yards. A number of the navy repair ships are completely equipped with Thermit welding outfits with which they are doing very important work.

The United States Government used large quantities of Thermit on the Panama Canal for welding broken parts of dredges, dipper buckets, locomotives, rock crushers, rock drills and air compressors. Now that the great enterprise is completed, the process is still retained and is being used in repair shops for maintaining equipment, for repairs on vessels passing through and vitalizing the dry dock for that purpose.

Heavy crankshaft repairs present a very interesting application for Thermit welding, showing considerable saving in time and money. A great many of the steel mills in Pennsylvania, Ohio and Indiana use Thermit for heavy welding of crankshafts, rolls, housings, pinions, shears and other heavy sections.

Pipe welding is a broad field for Thermit. This is done quickly and cheaply. A Thermit welded pipe is stronger at weld than any other part of pipe. Tests have been made for tensile strength, also hydrostatic and vibration tests, and in all cases have broken away from weld. I have a 2½-inch double extra heavy pipe that has been pulled for tensile strength at one of the steel mills in the Pittsburgh district, which broke 4 inches away from weld, for exhibit here tonight.

It is in rail welding for street railways that the Thermit process offers one of its greatest fields of usefulness. The apparatus is simple in the extreme and enables a few joints to be welded almost as cheap as a large number. Street railway companies are realizing more and more the importance of installing permanent joints in place of mechanical joints and welding is the only means to attain that end. The life of the rail depends very greatly on the efficiency of the joint, as the rails always wear out and pound where the joint occurs.

AUTOGENOUS WELDING IN THE RAILROAD SHOP†

By Edward Eldridge.

IN discussing the subject of electric and acetylene welding at the Elizabethport shops of the Central Railroad of New Jersey, I may say that we have had wonderful success in both boiler and locomotive work. In the erecting shop we weld frames, cylinders and castings of all kinds, both with the electric arc and acetylene. We also weld superheater units. In the machine shop department we are welding cross heads, valves, driving wheels and building up worn parts that are too numerous to mention. The boiler department also comes in for its share and here we are welding whole fire boxes, ½ fire boxes, ½ throat sheets, backheads, door-rings, patches, large cracks, flues and patches on tanks.

Frame Welding

When welding broken engine frames the frame is trammed and leveled, after which it is V'd out about 45 degrees on both sides with the acetylene cutter. It is then chipped to remove all scale and burned material. The next step is to expand the frame about ⅛ of an inch in order to take care of contraction. To get this expansion we use a charcoal fire on the rail that is not broken, and as this expands, it will open the one in which the break is located. Two welders are then put on to weld, one on either side. When they get one layer welded on, they take an air hammer and bob it to get the scale and dirt off before starting another layer and continue in this way until the frame is welded flush. The welded joint in the frame is then re-enforced by use of ⅝ inch or ¾ inch round mild steel bars which are put across the weld and extend two inches on either side of it. These bars are spaced from an inch to 1¼ inches apart and are welded in solid where possible. Bars placed in this manner greatly increase the tensile strength of the frame at the welded joint. In welding single rail frame, the rail is expanded on the opposite end to get the expansion where the break is located. Afterward the weld is made in the same manner as in the case of the two welded rail frames.

Cylinder Welding

In welding engine cylinders that are cracked or broken we are doing it with both the electric arc and acetylene. When welding with acetylene, the crack or broken cylinder is V'd out to a 45 degree angle and the opening left from ⅛ inch to ⅜ inch on bottom of the crack. A frame is then built around the cylinder which is heated to a cherry red heat with a charcoal fire before starting to weld. In using an alloy cast

†*Extract from a paper read before the American Welding Society, Metropolitan Section, New York City, March* 15, 1921

iron rod for filler, care must be taken not to chill the iron or it will be hard. After the weld has been completed and has cooled, the furnace is taken away and the cylinders bored or trued up.

In welding engine cylinders with electric metallic arc, all cracks or broken parts are V'd out or beveled to a 45 degree angle and studs applied. The size of stud is used according to the thickness of the casting. Where the casting is one inch or over we use a ¾ inch or a ⅞ inch stud. These are placed about two inches apart, using one row in the crack and two rows outside, one row being on either side of the crack. Wherever a new piece is set in to replace a piece broken out, we use forged steel, with studding applied only to the cast iron. In making the weld, a light layer is placed around each stud first. Then the layer is put on where the weld is going to be applied, after which you have steel to steel to weld. After the weld is finished, white lead is put on the inside of the cylinder to do away with leaks or pin holes which forms next to the cast iron. When a joint comes in the weld, we braze "Tobin" bronze so as to leave a soft joint to machine. This bronze is brazed on with acetylene. If no acetylene is used, a small piece of copper is dove-tailed at the joint.

Steel Casting and Other Pieces

In welding broken or cracked iron, steel or cast steel castings, the casting must be V'd to about a 45 degree angle, and the crack extended through to a feather edge so that the weld will get all the way through. Care must be taken to get all grease or dirt off, as this will get into the weld and weaken it. If a casting is warped out of shape, it will not spring if it is welded from both sides, a little welding being done on each side alternately until the weld is completed.

Bars of steel for re-enforcing are always used as the grain runs across the weld in all directions. In welding superheater units we found the acetylene weld was better than the electric. Where the unit is cracked on the return end, the proper way is to cut off the end about one inch in order to get into good material. A cap made of ¼ inch mtaerial is then welded on. By using a cap the weld will be on the side of the unit instead of on the end and the greatest heat will strike the cap, which is the thinnest part, and will stand this heat as the steam passing through will keep it cooler.

Machine Department

In repairing crossheads where the flanges are worn down we are welding on a ⅝ inch strip. The strip is beveled on both sides of one edge on the planer, after which it is taken and welded on both sides, bringing it back to its original size. The guides which are worn on the side are built up to the original size. By applying strips 1 inch to 1¼ inches wide, beveled from both edges and welded through the sides of the guide, the guides are brought up above standard size, after which they are planed down to the proper dimensions. In building up worn castings which are to be machined down, great care must be take not to over-lap the layers as this is the cause of black or hard spots in welding.

Fire Box Welding

In welding complete fire boxes, we use a butt weld. The sheets are beveled on the inside and set in place on the mud-ring, then tacked in the water space. All fire boxes are welded on the floor. Starting in the center of the flue sheet at the bottom, the weld is made up to the ear or lap. The fire box is then turned over and the welding continues from the center of the crown sheet to the mud-ring, giving ⅛ inch re-enforcing. After completing the weld on this side, the box is again turned and with a round nose chisel, a groove about ⅛ inch deep is cut in the seam in order to get all the scale and dirt off. This groove is then re-enforced with ⅛ inch or one inch layer of welding metal. On the flue sheet we put ½ inch by three inches round mild steel bars and weld around it. On the throat sheet five bars are used in the same way. The reason for putting on these bars is to stiffen the flue sheet when the flues are rolled. In welding half throat sheets and backheads, the sheets are beveled the same as the fire box side and welded before rivets are put in, giving about ⅛ inch by ⅛ inch re-enforcing.

In welding mud-ring corners we put a fillet weld on the inside through plug holes and re-enforce ½ by 1¼ inch by 12 inches on the outside.

In welding ½ fire boxes we use a staggered seam, starting the cut back from the throat sheet two staybolts, then up one staybolt. The seam then goes back two staybolts, down one, back two and so the length of the fire box. By staggering seams expansion and contraction is scattered in all directions.

In welding patches in fire boxes we use an oval patch so there will be no sharp corners. The patch has a ⅛ inch radio so that there will not be any strain after the weld has been made. In applying the patch after the top and sides have been tacked on, the weld is begun at one end of the patch and continued across the top. The ends of the patch are welded from the top down, first welding about three inches on one end and then the same amount on the other until the ends are completely welded. The patch welding is then completed by beginning at one end at the bottom and continuing to the other end, and re-enforcing about ⅛ inch. By welding this way the heat from the welding travels up into the patch and the contraction will straighten out the patch.

In welding cracks in fire boxes where they are over four inches long, the crack is V'd out to a feather edge. The welding is begun three inches from the top and the weld continues to the top. Welding is then begun about three inches further down and continues upward as before and so on until the crack is filled up. The next step is to take a welding hammer and bob up the welding material that has been applied and put on ⅛ inch re-enforcing. Cracks welded in this manner we have had hold for two or three years.

In welding door-holes we weld some with the lap and some with butt weld. In welding a lap weld care must be taken to keep the sheets laid up tight at all times and a fillet weld is applied on the edge. Care must also be exercised to see that the weld is as thick as the sheet in all places.

In welding flues in the fire box end, we put the flues in the same as before welding was practiced. The boiler is then filled with warm water so that it will not sweat, and with a roughing tool all dirt and scale was cleaned from the sheet. With an acetylene torch or blow pipe all grease and oil are burned from the flue and sheet. The work is begun at the top of the flue sheet and progresses across so that the smoke will get on the flues that are already welded and not on the ones to be welded. Always start to weld a flue at the bottom, welding up each side to the top. Care must be taken that there is no copper sticking out of the sheet as this will cause blow holes in the weld. In welding upright boilers roll and expand the flue and do not bead or use any copper ferrules. Leave the flue about ⅛ inch from the sheet and weld the bead on.

WANAMAKER ADDRESSES CLEVELAND SECTION

"The Practical Application of Electric Arc Welding" was the subject of a talk given by E. Wanamaker before the Cleveland Section of the American Welding Society, at the Hotel Statler, Cleveland, June seventh.

The following officers and directors have been elected by the Cleveland Section:

Acting Chairman—Royal D. Malm.

Acting Secretary and Treasurer—Henry Spero.

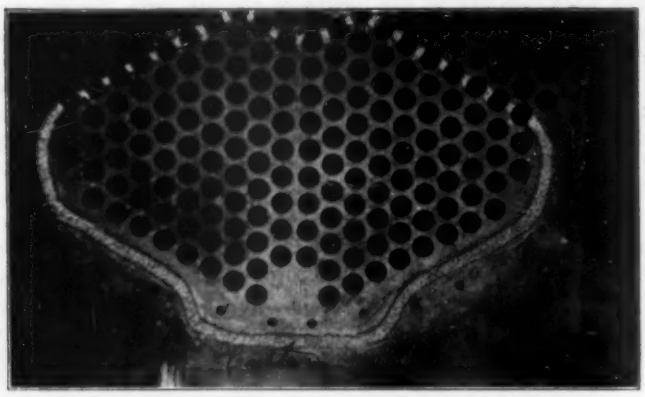
Address fourth floor Euclid Arcade Building, Cleveland, Ohio.

Board of Directors—C. L. Bennet, C. J. Nyquist, R. S. Sawdey, C. F. Eberhart, V. R Holt, F. L. A. Smith, R. D. Malm, H. G. Gray, J. C. Lincoln, Hugh H. Dyar.

Several to be appointed will complete the directorate.

ARC WELDED PATCH ON FLUE SHEET

The photograph shows a patch inserted in a flue sheet on locomotive No. 11, of the West Virginia Pulp & Paper Co.'s mechanical maintenance plant at Cass, W. Va., which patch is placed so that the weld goes through the bridges between flues. This is an unusual welding job and there were two locomotives welded in this manner.



This Weld Stood Severe Pressure and Service Tests

The weld was made, of course, with the flues out, but without any machining whatever in the holes in the flue sheet. All the welding was done from the front side, and during the necessary beading and rolling on the flues, no cracks or any distortion of the weld developed. The part of the weld which does not go through the flue bridges wends its way between the stay bolts, and in the heavy pounding necessary to head these over in place, no damage was noted in the weld.

The cold-water test was at 265 pounds pressure and the engine has been in service at 200 pounds steam pressure where the service is very severe—the locomotives go practically straight up and over the mountains, the road bed is none too good; and on the up grade the boiler is panting, and on the down grade there is a maximum of oscillation and concussion.

The weld was not touched with a caulking tool and is in service just as shown.

CUTTING TORCH CUTS FLUE HOLES

Acetylene cutting torches are now used by ,the Southern Pacific Railroad Co. in cutting flue holes in flue sheets. The cutter is attached to a radial bar as shown in the accompanying photo which is operated from the center of the hole, the point of the cutting torch revolving around similar to the compass.

Less than one-half minute is required to cut a flue hole. This method of cutting flue holes has been found to be a great saving in time and cost over the usual method of drilling holes.

Operator Cutting Flue Holes

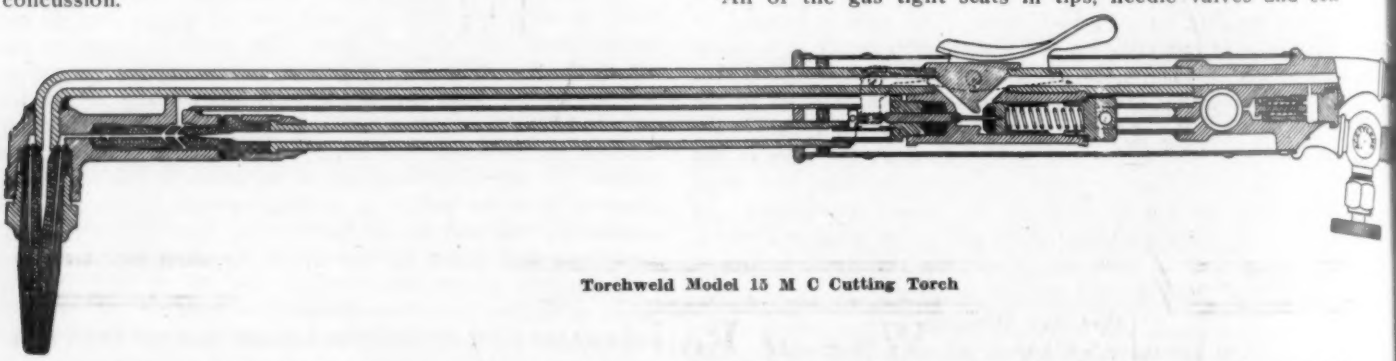
The man operating the torch has become very expert in the use of the cutting torch. One false move on the part of the man operating the torch would ruin the whole flue sheet.

TORCHWELD MODELS 15 MC. AND 25 MC. CUTTING TORCHES.

The gas cutting torch illustrated herewith is manufactured by the Torchweld Equipment Co., of Chicago. It is designed to use oxy-acetylene, oxy-hydrogen, or oxy-hydrocarbon gases, such as butane, calorene and the like. Special tips are furnished for the special gas combinations. An 85-degree torch head angle is standard, but 70, 50 and 35-degree and straight heads can be obtained if desired.

A one-piece cutting tip is used and the mixing chamber is located just back of the torch head. A novel and individual feature of the construction is that an annular space is provided around the mixer in which small amounts of gases accumulate. Drill holes connect this space with the gas passageway leading to the tip, and in case of back fire to the mixing chamber, the ignited mixture in the annular space is designed back into the flexible connecting hose.

All of the gas tight seats in tips, needle valves and connections are of the line contact type. In other words a convex surface is brought into contact against either a flat surface or another convex surface. A tight seating is thereby more easily obtained than by using two flat surface contacts.



Torchweld Model 15 M C Cutting Torch

The back pressure valve prevents the acetylene from entering the oxygen hose, since a certain pressure of the oxygen is necessary in order to open this valve. Therefore, the acetylene pressure tends to close the valve still tighter.

Model 15 MC. is identical to 25 MC. with the exception that the latter is furnished with a two-piece tip which is used on rusty metal and heavy duty in steel foundries.

"Standards for Testing Welds," which appeared in the May issue of *The Welding Engineer* will soon be ready for distribution in bulletin form to members of the American Welding Society.

A Small Investment That Pays Big Returns

EVERYWHERE—in repair shops, in industrial plants—in service stations and—in all kinds of outside repair work, Smith's Welding, Cutting and Carbon Burning Equipment Plants are in strong demand—because they can be had in any size needed—because they are adaptable to all kinds of work—and because they enable the best welding and repair work at lowest cost.

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Proper protection for the welders' eyes has been given our undivided attention. Suffice to say we offer only the proven correct types.

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A Welding Wire or Rod for Every Purpose

Are you experiencing any difficulties in welding your products? If so, submit these problems to us. Let us prescribe the filler which will solve your difficulties.

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NONOX SWEDOX
For general acetylene welding.

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For acetylene welding of cast iron.

CARBOX
For acetylene or electric welding of steel castings.

VANOX
For acetylene or electric welding of Vanadium steels.

NICKOX
For acetylene or electric welding of nickel steels.

KROMOX
For acetylene or electric welding of chrome nickel steel.

RAILOX
For acetylene or electric welding of high carbon steels, building up rails, etc.

BRONZOX
For acetylene welding of Malleable Iron, Bronze and Brass.

MANGANOX
For acetylene or electric welding of high manganese steels, frogs, switch points and crossings.

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Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Counted 8 words to line. Add 6 words for keyed address.

Wanted—Salesmen, Demonstrators, Welders and others meeting the welding trade to solicit subscriptions to *The Welding Engineer*, or furnish names of possible readers. When you put your friend or customer in touch with this publication you do him a real favor—make it possible for him to learn more about autogenous welding, liberal proposition. Write me now. Yours for welding, Mackenzie.

Wanted—Position as welding instructor or welding foreman, by welder of six years practical experience. Two years instructor of the oxy-acetylene process. Address: Welding Instructor, Y. M. C. A. School, Denver, Colo.

For Sale—Machine and Welding Shop in a good farming district in Oregon, doing $100.00 business a day; will invoice at $20,000.00. Did $6,000 business last year. $5,000 cash and balance on long time to right party. Address 82, care *The Welding Engineer*.

Position Wanted—Arc welder with nine years' experience. Two years experience at gas welding. Familiar with all types of machines. Boiler and tank work a specialty. Instructor for past two years. Desires broader opportunity. Address 83, care *The Welding Engineer*.

Position Wanted—Executive. Graduate mechanical engineer with very broad experience in the welding industry and along manufacturing lines. Would like to become connected with sales organization of a progressive concern dealing with welding apparatus. Address 84, care *The Welding Engineer*.

Position Wanted—Arc welder with six years' experience on all kinds of metal. Thoroughly familiar with tank and boiler work. Also experienced in oxy-acetylene welding. Address 85, care *The Welding Engineer*.

Position Wanted—Oxy-acetylene welder with nine years' experience. Demonstrating and sales experience also. Good references. Wish to leave present location to secure change of climate for family. Address Earl De Santis, Fellows, California.

Position Wanted—Electric and gas welder with three years' experience. Full knowledge of boiler and repair work. Best References. Will locate anywhere. Address H. Parker, 400 N. First St., Hopewell, Va.

Position Wanted—Welder and instructor of welding would like to connect with firm who want a steady man to work for their interests, and will appreciate satisfactory service by advancement. Address 86, care *The Welding Engineer*.

For Sale—Oxweld duplex acteylene generator of 500-pound capacity; also a 10-cylinder manifold for this generator; good condition; real bargain. Address 75, care The Welding Engineer. 2t—May-June

Wanted—Position, by gas welder; experienced in sheet metal work. Will take cutting or helping job to start. Address George Ray, 251 West Twenty-eighth Street, Chicago.

NYQUIST WITH CARBIC MFG. CO.

On June 15th, C. J. Nyquist is to join the organization of the Carbic Mfg. Co. at Duluth, Minn. Mr. Nyquist is well known to the trade as a designer and maker of oxy-acetylene welding apparatus. For some time he has been conducting a welding and supply business at Cleveland and while there has been active in promoting the organization of the Cleveland Section of the American Welding Society.

HAUCK MFG. CO. ELECT H. T. GERDES PRESIDENT

The Hauck Mfg. Company, Brooklyn, N. Y., manufacturers of Oil Burners, Oil Forges, Oil Burning appliances, etc., have elected as their President Mr. Henry T. Gerdes, Mechanical Engineer and manufacturer of New York; first Vice-President, M. C. Hauck; second Vice-President, A. B. Hauck; third Vice-President, H. H. Kress; Treasurer, A. H. Stein; Secretary J. Lutz.

Mr. H. T. Gerdes, who succeeds the late Arthur E. Hauck, is well fitted for his new position. He is a graduate of Stevens Institute of Technology and was for many years manager of the Treadwell Engineering Co. of Easton, Pa. Mr. Gerdes has a practical knowledge of the manufacture of Oil Burning Torches and Appliances.

A. E. Hackett, welding engineer, has taken charge of the office of the Federal Machine & Welding Co., Warren, Ohio, at 1724 Dime Bank Building, Detroit. This office formerly was in charge of Arthur E. Meyer, who also represented the Federal company at Chicago, and who has severed his connections with this company and moved to Hollywood, Cal. Stanley Mazurez, Jr., will take charge of the office at 15 South Clinton Street, Chicago. Mr. Mazurek has been assisting in the selling organization for some time, but now assumes full control of the Chicago office.

The Ohio Electrolytic Oxygen Company has purchased a piece of ground in Cincinnati for the purpose of enlarging its plant.

CANADIAN COMPRESSED GAS MANUFACTURERS MEET

The Canadian Section of the Compressed Gas Manufacturers Association held a meeting in Toronto on June 7. Eighteen representatives were present. The meeting followed a luncheon. Major J. C. Minor addressed the meeting, explaining the research work now being done by the association.

The Compressed Gas Manufacturers Association is about to begin work in connection with Oxygen regulator research.

AGENTS

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RULING OF WISCONSIN INDUSTRIAL COMMISSION

(Continued from Page 34.)

very large number of industrial plants in Wisconsin which generate their own acetylene, and many of which have medium pressure generators, not one of these plants has ever written the commission to inquire whether they are forbidden to use medium pressure generators, or protested against a single one of the orders which the commission has adopted to govern the operation of the two central stations in Wisconsin.

"The commission has not adopted any orders governing either the manufacture of acetylene on a small scale in industrial plants, nor any safety orders relating to acetylene welding. As has been stated, the commission intends to cover these fields by orders to be issued hereafter, but such orders will be promulgated only after careful study of the hazards presented. It does not follow that, because the commission has barred out medium pressure generators from the central stations, that it will also rule them out of industrial plants when orders are made to govern the same. Such advice as the commission has obtained to date is to the effect that in industrial plants medium pressure generators present a much smaller hazard than in central stations, both because the volume of gas produced is much smaller, and because it is not necessary to pass the gas through a compressor to compress it to atmospheric pressure, as is done in the central stations.

"When the issue as to safety is confined to central stations, as it must be, it is acknowledged that practically all the generators in use in such establishments throughout the country are low pressure generators. The medium pressure generators which the petitioners seek to have admitted to the central stations are used extensively in industrial plants and are also used in the navy yards of the United States, but only one instance was cited to the commission in which a medium pressure generator is now in use in a central station. The primary reason why medium pressure generators have not been used in central stations appears to be that the gas must, in any event, be passed through a compression chamber after being generated, and it, consequently, is of no commercial advantage to raise the pressure in the generator to fifteen pounds, when it can be just as economically generated with a pressure not to exceed that produced by a head of a column of twenty lineal inches of water—approximately three-quarters of a pound.

"The petitioners have also attacked that portion of order 4635 which provides that when carbide dust is used the generator must be supplied with an agitator. This provision is attacked—first, on the ground that an agitator is required regardless of whether carbide dust or lump carbide is fed, and second, because it is alleged to require a particular patented agitator, the patent upon which is owned by the Union Carbide and Carbon Corporation. Neither of these allegations is well founded. There is no question that the advisory committee and this commission interpret order 4635 as requiring an agitator only when carbide dust is used. Nor is any patented agitator prescribed in the order of the commission. The only agitator required is one 'which will keep the water in constant circulation in the generating chamber while carbide is being introduced in order to avoid the settling or formation of large quantities or islands of carbide dust.' Any agitator which will accomplish this purpose will meet the requirements of the orders of this commission. It is acknowledged that the Gas Tank Recharging Company has equipped the generator which it purchased from the Alexander Milburn Company with an agitator which meets the requirements of the commission, and this agitator was not purchased from the Union Carbide and Carbon Corporation or any of its subsidiaries, and we believe does not infringe its patent. Mr. Smith of Smith's Inventions, Incorporated, one of the petitioners, at the public hearing upon this petition also described an agitator which already meets the requirements of our order and yet is different from the agitator covered by the King patent, which the petitioners represent is the agitator required by order 4635.

"While we are thus obliged to reach the conclusion that the modifications sought by the petitioners in orders 4600 and 4635 are not in the interests of safety—a conclusion which corresponds with the advice unanimously given by the members of the advisory committee who sat with the commission both at the public hearing and in the argument upon this petition—this commission will on its own motion make two slight modifications in order 4635 to more clearly express our intent.

"In accordance with the above memorandum, this commission herewith makes the following findings of fact:

"1. That general orders 4600 and 4635 relate only to establishments engaged in the manufacture and compressing of acetylene into cylinders for sale or transportation to users other than the manufacturers and not to other manufacturers of acetylene;

"2. That the allegations of the petitioners, that representatives of the Union Carbide and Carbon Corporation procured the adoption of general orders 4600 and 4635 through fraudulent representations made to the advisory committee on gas hazards and to this commission, are not sustained;

"3. That the modifications sought by the petitioners in general orders 4600 and 4635 will not adequately protect the life, health, safety and welfare of employes and frequenters in establishments engaged in the manufacture or compressing of acetylene into cylinders for sale or transportation to users other than the manufacturers:

"4. That slight modifications of general order 4635 are desirable for the sake of clarity.

"It is, therefore, ordered:

"1. That the petition of the Alexander Milburn Company, Baltimore, Maryland, and the intervening petitions of the Imperial Brass Manufacturing Company of Chicago, Illinois; the United States Welding Company, Minneapolis, Minnesota; Smith's Inventions, Incorporated, Minneapolis, Minnesota, for a modification of general orders 4600 and 4635 be and are hereby dismissed.

"2. That general order 4635 shall be modified to read as follows:

Order 4635. The carbide to water type of generator shall be used.

Generators shall be provided with liquid seal safety devices which will prevent an undue pressure in the generator.

Generators having a gas receiving bell as an integral part thereof shall not be used.

The water seal shall be designed to provide a normal working pressure not to exceed twenty lineal inches of water column.

Every generator shall be plainly marked with the maximum number of cubic feet of gas it is designed to supply per hour. The manufacturer's name and address and the trade name or designating marking of the machine.

When carbide dust is used, the generator shall be supplied with an agitator which will keep the water in constant circulation in the generating chamber while carbide is being introduced in order to avoid the setting or the formaton of large quantities or "islands" of carbide dust. The carbide feeding device shall be so arranged that it will be inoperative when the internal agitating apparatus is not in motion.

The sludge or discharge valves of the generator shall be piped to the outside of the building, and no open troughs for conveying the residue inside the building shall be permitted.

All electric motors inside the building shall be of the alternating current induction type. When direct current motors are used, they shall be located on the outside of the building in a small separate building, used for that purpose only.

Switches controlling motors shall be of the non-sparking type or shall be located outside the building.

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CURRENT WELDING LITERATURE

ARC WELDING APPLIED TO REFRIGERATING MACHINERY, by A. M. Candy.—The three reasons why arc welding has not been more extensively used in manufacturing are: first, an insufficient supply of trained operators; second, a lack of confidence in welded joints; third, a limited understanding of methods of control and inspection. This paper points out how arc welding apparatus can be used to advantage for repairing a large variety of defective or damaged shop machinery and also deals with some of the underlying fundamental welding principles, with a view to stimulating the manufacturers to use the arc welding process more extensively in manufacturing. The author describes tests and experiments of record that show the possibilities of the process, and recommends that the process be developed as far as possible, by further research.—Journal of the American Society of Refrigerating Engineers, January, 1921.

SOME TESTS ON WELDED AMMONIA CONTAINERS, by E. A. Fessenden.—The object of the tests was to compare different methods of constructing the cylinders for handling anhydrous ammonia in refrigerating plant practice. The cylinders tested involved the following four types of construction: 1. Flange steel shell, acetylene welded longitudinal seam, concave heads forge welded to shell. 2. Seamless pipe shell, convex heads acetylene welded to shell. 3. Seamless pipe shell, concave heads forge welded to shell. 4. Flange steel shell, acetylene welded longitudinal seam, convex heads acetylene welded to shell. The tests indicated that the best type was that made of seamless pipe shell with acetylene welded dished heads, convex outward. This construction places the welds where they have to sustain a minimum stress.—Journal of the American Society of Refrigerating Engineers, January, 1921.

PREHEATING PRACTICE, by David Baxter.—Preheating a fundamental to successful welding procedure, an art in itself. Several common examples.—Acetylene Journal, June.

AUTOGENOUS WELDING FOR LOCOMOTIVE BOILERS.—In the report of the Chief Inspector of Locomotive Boilers to the U. S. A. Interstate Commerce Commission for the year ending June, 1920, attention is directed to some explosions where the failure of seams united by welding was considered a strong contributing factor to the seriousness of the accident. The opinion is expressed that such methods should not be applied on any part of the boiler where the tress to which the structure is subjected is not carried by other construction, nor in the so-called low-water zone of a firebox where overheating and failure are liable to occur. This applies with equal force to all parts of the locomotive and tender subject to severe strains and shocks, where, through failure, accidents might occur.—Report of the Chief Inspector of Locomotive Boilers, Railway and Locomotive Engineering., January, 1921.

THE SANDBERG "IN SITU" RAIL HARDENING PROCESS, by A. E. Shorter.—An interesting application of the oxy-acetylene flame. Consists of heating rails already in service, with the torch, and then quenching with water. In one experiment, rails treated by this process, after 360,000 cars had passed over, remained unaffected, although subjected to precisely the same influences which caused adjoining lengths of untreated rails to corrugate.—Industrial Gases, March.

THE PENETRATION OF WELDS, by R. Granjon.—In a great number of industrial cases the welds which are best executed from other points of view become the worst and the most dangerous if there is a lack of penetration.—Revue de la Soudure, Antogene, April.

Notice has been filed of the organization of The American Welding Co., 24 W. Kinney St., Newark, N. J., to operate a welding, brazing and cutting plant. The president of the new company is Maurice Rehrlich.

Julius F. Klose, has been for some years engaged in business at 219 E. 24th St., Chicago, under the trade name of Klose Welding Company, not inc. His business has grown until he feels the time has come when it should be incorporated. With this end in view he and his associates have taken out a charter under the laws of Illinois for Klose Weld Engineering Corporation. Mr. Klose will be president and executive head of the new organization.

TORCH CLEANSES CONDEMNED FREIGHT CARS

Discovery that the oxy-acetylene torch is a practical method of burning out oil and tar in box cars, condemned as unfit for flour loading in Minneapolis is saving the railroads and millers of the northwest thousands of dollars and will insure hereafter an adequate supply of box cars for the millers.

KARL G. ROEBLING

With deep sorrow we announce the death of Karl G. Roebling, president of John A. Roebling's Sons Company, which occured on Sunday, the twenty-nineth day of May.

CHANGES IN PAGE STEEL AND WIRE OFFICES

W. H. Bleecker, Jr., formerly District Sales Manager at the Chicago office of the Page Steel and Wire Company is transferred to the New York office in the same capacity.

E. J. Flood has been appointed District Sales Manager for all Page products at the Chicago office, succeeding Mr. Bleecker.

At the Eighth Western Meeting of the American Society of Refrigerating Engineers, held at the Hotel Drake, Chicago, May 25 to 27, A. M. Candy presented an illustrated paper on "Arc Welding Applied to Refrigerating Machinery," and E. A. Fessenden read an illustrated paper on "Tests on Welded Ammonia Containers."

FOR THE ATTENTION OF THE MANUFACTURER

A firm of ship repairers in France desires to purchase electric welding outfits complete, from motor to welders' gloves and face protectors. Quotations should be given f. o. b. New York or c. i. f. French port. Cash to be paid. Correspondence should be in French. Address 34908, care U. S. Bureau of Foreign and Domestic Commerce.

A new line of acetylene generators is being marketed by the Caddo Manufacturing Co., Anadarko, Okla. The officers of the company are: A. Youngheim, president; C. J. Schutz, vice-president; F. M. Fulkerson, treasurer; O. C. Stephenson, secretary.

Announcement has been received of the incorporation of the Mercer Welding Rods Co., Trenton, N. J., to manufacture iron and steel welding rods and other specialties.

The Cave Welding & Manufacturing Co., Springfield, Mass., announce removal of their entire equipment to 62 Taylor Street, Springfield.

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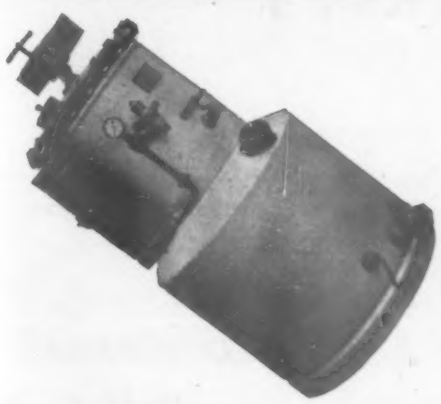

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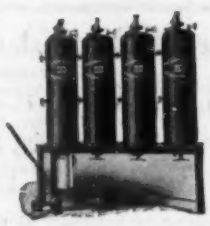

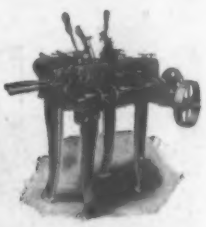

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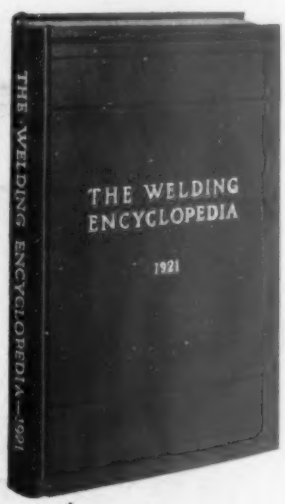

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